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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 22, NUMBER 10
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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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For primary bibliographic entry see Field 2K.
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2. WATER CYCLE

2A. General

QUALITY ASSURANCE PROGRAMME FOR HYDROMETRIC DATA IN NEW ZEALAND,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 7B.
W89-10763

KARST HYDROLOGY: WITH SPECIAL REFERENCE TO THE DINARIC KARST,
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
O. Bonacci.
Springer-Verlag, Berlin, New York. 1987. 184 p.

Descriptors: *Karst hydrology, *Groundwater movement, *Sinks, *Surface-groundwater relations, *Geohydrology, Case studies, Water circulation, Aquifers, Drianage patterns, Geomorphology, Yugoslavia.

Karst is characterized particularly by special landforms and subsurface drainage. The various actions of water result in numerous variations of surface and subsurface karst forms. They also bring about distinctive geologic-morphologic forms, and more strikingly, specific flora and fauna. The scientific discipline of hydrology, although a long-established science, cannot easily be applied to karst regions with their very complex drainage system. A special approach is therefore necessary to understand and predict water circulation in these areas. Most of this book gives a general approach to karst phenomena; however, numerous practical examples are also presented. The majority of the examples refer to the Dinaric karst areas in Yugoslavia but there are numerous examples from the other parts of the world also (United Kingdom, France, the Soviet Union, Switzerland, etc.). (Lantz-PTT)
W89-10961

2B. Precipitation

MODELING YIELDS FROM RAINFALL AND SUPPLEMENTAL IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
G. H. Hargreaves, Z. A. Samani, and E. Zuniga.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 239-247, April 1989. 1 fig, 1 tab, 17 ref.

Descriptors: *Model studies, *Crop yield, *Rainfall, *Irrigation, Evapotranspiration, Weather simulation, Climatic data.

The use of crop-yield models provides a tool for determining how best to combine benefits from rainfall and irrigation. Some developments are described that facilitate the modeling of crop yields. A method that requires only temperature measurements for reliable estimates of potential evapotranspiration facilitates modeling at many locations where more complete climatic data are not available. A weather simulation procedure that provides good results without local calibration and requires only monthly climatic data input makes it possible to develop a worldwide climatic data base for use with the existing crop-yield models that otherwise require the availability of daily climatic data. Estimated probable relative yields for rainfed agriculture, and with one irrigation and with two irrigations, are calculated with a yield model operated with actual daily data and with data synthesized from a monthly climatic data base. The difference in yields calculated from historical data and synthesized data varies from 0 to 17%. (Author's abstract)
W89-10560

TELECONNECTION BETWEEN SEASONAL RAINFALL OVER EAST AFRICA AND GLOBAL SEA SURFACE TEMPERATURE ANOMALIES,
Nairobi Univ. (Kenya). Dept. of Meteorology.
L. J. Ogallo, J. E. Janowiak, and M. S. Halpert.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 6, p 807-822, December 1988. 9 fig, 45 ref.

Descriptors: *Climatology, *Meteorology, *Rainfall, *Africa, *Water temperature, Seasonal variation, Sea surface temperature, Statistical analysis.

Global sea surface temperature (SST) anomalies within +or-30 degrees latitude of the equator were correlated with the time series of the major rotated principal component analysis (RPCA) modes of the seasonal rainfall over East Africa (Kenya, Uganda, and Tanzania) for the period from 1950 to 1979. Regionally averaged rainfall anomalies were also correlated with the SST anomalies. The physical reality and climatological stability of the computed correlations were investigated using 6 degree by 6 degree gridmesh SST records instead of the optimal 2 degree by 2 degree values. The stability of the patterns were further tested by random removal of a maximum of up to five pairs of the SST and rainfall records from the original data sets. The results from the study indicate significant instantaneous (zero lag) and time lagged correlations between SST anomolies over portions of the global oceans and some of the principal seasonal rainfall modes in East Africa. The maximum instantaneous correlations occur in the boreal autumn between SST anomalies int he Pacific Ocean and the autumn rainfall RPCA mode, which is dominant over the coastal regions. The spatial patterns of the significant correlations indicate a 'see-saw' pattern between the eastern Pacific Ocean and the Indonesia region which coincides with positive rainfall anomalies over the coastal regions of East Africa, and indicates a relationship between rainfall variability in this region and the El Nino/Southern Oscillation (ENSO) phenomena. Lower spatial and temporal persistence is observed between SST anomalies and the rainfall RCPA modes that dominate inland. The maximum variance of the seasonal rainfall that could be accounted for by the SST anomalies was about 40%. (Author's abstract)
W89-10566

SUPERCOOLED CLOUD TUNNEL STUDIES ON THE GROWTH OF SNOW CRYSTALS BETWEEN -4 AND -20 C,
Utah Univ., Salt Lake City. Dept. of Meteorology.
T. Takahashi, and N. Fukuta.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 6, p 841-855, December 1988. 17 fig, 1 tab, 23 ref. NSF grant ATM-82-18966.

Descriptors: *Cloud physics, *Snow, *Supercooling, *Clouds, *Crystal growth, Cloud tunnels, Polycrystalline snows, Fall velocity.

Snow crystal growth in free fall by vapor diffusion under water saturation and riming was studied up to 30 min in a supercooled cloud tunnel. The results showed that growth rates were pronouncedly highest along a-axis at -5.5 C. Each peak coincided with the growth of dendrites and needles, respectively. Polycrystalline snows, consisting of spatial dendrites and spatial plates, were observed very frequently below -15 C. The variation of fall velocity with growth time could be expressed by two straight lines, except for the temperature zone of dendritic crystal growth, where a curve and straight lines were fitted. The empirical relations between crystal fall velocity and growth time under constant temperatures were divided into two groups. In the higher fall velocity group, isometric crystals grew and rimed; in the lower fall velocity group, shape enhancement occurred during continuing vapor diffusional growth. The crystals in the former group dropped from 700 to 800 m, and those in the latter only 300 to 400 m in 30 min. Isometric crystals grown at around -10 C changed into graupel. The growth mode was roughly proportional to t to the 1/2 power, t squared and t to the 6th power in each corresponding stage. In the vapor diffusional and graupel growth stages, the particles followed Stokes' and Newton's laws of resistance, respectively. (Author's abstract)
W89-10567

QUANTITATIVE INVESTIGATION OF RATE DETERMINING PROCESS OF GROWTH OF SNOW CRYSTALS--TWO-DIMENSIONAL NUCLEATION GROWTH AND SPIRAL GROWTH,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
For primary bibliographic entry see Field 2C.
W89-10568

SQUALL LINE LIKE CONVECTIVE SNOWBANDS OVER THE SEA OF JAPAN,
Meteorological Research Inst., Yatabe (Japan).
H. Sakakibara, M. Ishihara, and Z. Yanagisawa.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 6, p 937-953, December 1988. 10 fig, 1 tab, 23 ref.

Descriptors: *Convective precipitation, *Sea of Japan, *Snow, *Squalls, *Radar, Echo cells, Snowbands, Japan.

The internal structure of two convective snowbands, deduced by using mainly single-Doppler radar data, which developed over the Sea of Japan in winter, traveled nearly perpendicularly to their orientation, and showed common features is described. A typical snowband was formed in a convective mixed layer 4 km deep over the relatively warm sea surface in the early stage of a cold-air outbreak. This snowband was a multicell system which contained two or three echo cells in a vertical plane normal to its orientation. Each echo cell developed aloft in the forward portion of the snowband and became a mature echo cell in the middle of the snowband. The upper portion of old cells remains in a small anvil with low reflectivity below the stable layer in the rear part of the snowband. The snowband had the main updraft in its forward portion. The updraft tilted upshear and penetrated the stable layer above the convective mixed layer. There was a descending current from rear to front relative to the snowband in the lower part of the anvil. Snow particles evaporated in the downdraft. The leading edge of the downdraft was observed on the ground as a gust front with a severe gust and a drop in temperature of about 1 C. The circulation and maintenance mechanism of the convective snowbands was similar to those of tropical and midlatitude squall lines. (Author's abstract)
W89-10569

COMPARISON OF PARAMETERIZED NITRIC ACID RAINOUT RATES USING A COUPLED STOCHASTIC-PHOTOCHEMICAL TROPOSPHERIC MODEL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 5B.
W89-10701

SPATIAL AND TEMPORAL PATTERNS OF THE EAST AFRICAN SEASONAL RAINFALL DERIVED FROM PRINCIPAL COMPONENT ANALYSIS,
Nairobi Univ. (Kenya). Dept. of Meteorology.
L. J. Ogallo.
International Journal of Climatology IJCLEU, Vol. 9, No. 2, p 145-167, March/April 1989. 11 fig, 2 tab, 45 ref.

Descriptors: *Climatology, *Meteorology, *El Nino, *Africa, *Rainfall distribution, Temporal distribution, Spatial distribution, Principal component analysis, Correlation analysis, Lake Victoria, Indian Ocean, Mathematical studies, Statistics, Southern Oscillation, Inter-tropical convergence zone.

Rotated principal component analysis (RPCA) was used to study the spatial and temporal characteristics of seasonal rainfall over East Africa during the period 1922-1983. The RPCA solutions were derived from both spatial and temporal correlation matrices. The spatial correlation matrices described intercorrelation between pairs of stations, whereas the temporal matrices gave correlations between pairs of map patterns. Results obtained with the spatial correlation matrices indicated seasonal shifts in the patterns of the dominant RPCA modes that closely resembled the seasonal migrations of the rainfall belts induced by the Inter-Tropical Convergence Zone (ITCZ). The influence of large water bodies, especially Lake Victoria and the Indian Ocean, were outstanding throughout the year. Twenty-six homogeneous regional groups were delineated from the spatial characteristics of the dominant eigenvectors. Solutions based on the temporal correlation matrices clustered together some of the wet and dry episodes. Some of the map patterns clustered together could be associated significantly with El Nino/Southern Oscillation events. (Author's abstract)
W89-10764

CONTROL BY ATMOSPHERIC PRESSURE PATTERNS OF SULPHATE CONCENTRATIONS IN PRECIPITATION AT ESKDALEMUIR, SCOTLAND,
University of East Anglia, Norwich (England). Climatic Research Unit.
For primary bibliographic entry see Field 5B.
W89-10765

DEPOSITION OF AIRBORNE NITROGEN AND PHOSPHORUS ON THE COASTAL ZONE AND COASTAL LAKES OF SOUTHERN BALTIC,
Gdansk Univ. (Poland). Inst. of Oceanography.
For primary bibliographic entry see Field 5B.
W89-10790

ATMOSPHERIC CHEMISTRY-A LAY PERSON'S INTRODUCTION,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
J. M. Hales.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 71-89, 10 fig.

Descriptors: *Chemistry of precipitation, *Storms, *Mathematical models, *Acid rain, *Precipitation, *Water pollution sources, Chemical reactions, Convective precipitation, Sulfates, Ozone, Path of pollutants, Weather patterns.

In early modeling efforts of atmospheric chemistry, scientists visualized storms as a 'black box,' attributing some sort of an empirical scavenging coefficient to the box and then proceeding with estimates. This is not currently acceptable for defining the source-receptor sequence, because many mathematical nonlinearities are intrinsic within a storm system. In modern modeling practice, this is handled by applying what is known as the 'interaction diagram' concept. Interaction diagrams are formulated that define the transitions from one phase to another and one chemical species to another, or classes of phases or species. Formulas are then set up that depict those features mathematically. Examples are presented which illustrate patterns of precipitation, fall velocity, cloud water, sulfate isopleths, oxidation via ozone, and sulfate deposition, all as parts of models of precipitation scavenging of pollution. (See also W89-10965) (Lantz-PTT)
W89-10969

SIMULATING SOURCE-RECEPTOR RELATIONSHIPS FOR ATMOSPHERIC CONTAMINANTS,
Michigan Univ., Ann Arbor. Rocket Propulsion Lab.
For primary bibliographic entry see Field 5B.
W89-10971

FIELD-STUDY DESIGN FOR MODULE EVALUATION: PRECP VI/3CP0,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
For primary bibliographic entry see Field 5B.
W89-11008

STATISTICAL TECHNIQUES FOR REGIONAL MODEL EVALUATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W89-11009

2C. Snow, Ice, and Frost

SUPERCOOLED CLOUD TUNNEL STUDIES ON THE GROWTH OF SNOW CRYSTALS BETWEEN -4 AND -20 C,
Utah Univ., Salt Lake City. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W89-10567

QUANTITATIVE INVESTIGATION OF RATE DETERMINING PROCESS OF GROWTH OF SNOW CRYSTALS--TWO-DIMENSIONAL NUCLEATION GROWTH AND SPIRAL GROWTH,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
E. Yokoyama, and T. Kuroda.
Journal of the Meteorological Society of Japan JMSJAU, Vol. 66, No. 6, p 927-936, December 1988. 7 fig, 14 ref.

Descriptors: *Snow, *Crystal growth, *Nucleation, Supersaturation, Heat transfer, Diffusion coefficient, Latent heat, Kinetics.

The dependence on crystal size of the growth rate of snow crystals from vapor is theoretically obtained by taking into account the surface kinetic process and the heat conduction process under various growth conditions specified by the supersaturation and the diffusion constant of water molecules. The results are interpreted from the viewpoint of the change of resistances of individual processes with increasing crystal size. The surface kinetic process, the diffusion process and the heat conduction process are coupled to each other through mass conservation and heat conservation conditions at the ice surface. The resistance of the surface kinetic process is a decreasing function of the surface supersaturation which depends on growth conditions and the state of the surface mechanism of generation of steps. Therefore, the resistance increases in the following cases: (1) the supersaturation at infinity decreases, (2) the diffusion coefficient decreases, and (3) crystal size increases. In addition, it is larger for two-dimensional nucleation growth than for spiral growth. The resistance of the diffusion process increases with increasing crystal size, because the supply of water molecules towards the crystal surface becomes difficult with increasing surface area. Furthermore, it is inversely proportional to the diffusional constant, but independent of the supersaturation. The resistance of the heat conduction process also increases with increasing crystal size, since the release of the latent heat from the surface becomes difficult with increasing surface area, and it is independent of the supersaturation. Growth rate is inversely proportional to crystal size, either in the diffusion controlled case or in the heat conduction controlled case. (Miller-PTT)
W89-10568

SQUALL LINE LIKE CONVECTIVE SNOWBANDS OVER THE SEA OF JAPAN,
Meteorological Research Inst., Yatabe (Japan).
For primary bibliographic entry see Field 2B.
W89-10569

SOLUTE AND PARTICULATE CHEMISTRY OF BACKGROUND VERSUS A POLLUTED, BLACK SNOWFALL ON THE CAIRNGORM MOUNTAINS, SCOTLAND,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 5B.
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ISOTOPIC COMPOSITION OF METHANE RELEASED FROM WETLANDS: IMPLICATIONS FOR THE INCREASE IN ATMOSPHERIC METHANE,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
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2D. Evaporation and Transpiration

PREDICTION OF CLASS A PAN EVAPORATION IN SOUTHWEST IDAHO,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. A. Hanson.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 166-171, April 1989. 3 tab, 20 ref.

Descriptors: *Pan evaporation, *Evaporation, *Idaho, *Watersheds, Mountains, Mathematical studies, Mathematical equations, Prediction.

Monthly and daily Class A pan evaporation amounts were determined for a mountainous watershed and equations to estimate daily Class A pan evaporation were developed. Class A pan evaporation from three sites on the Reynolds Creek Experimental Watershed in southwest Idaho showed that a single equation that incorporated solar radiation and mean temperature could be used to estimate daily pan evaporation. The estimates could be improved by adding a daily wind run term to the basic equation. Daily evaporation varied between 7.5 mm/day at the mid elevation site (1649 m) and 6.5 mm/day at the highest elevation (2097 m). Daily amounts were very similar for the low elevation site (1193) and the mid elevation site. Total summer evaporation was 1255, 1082 and 795 mm for the low, mid, and high elevation sites, respectively. (Author's abstract)
W89-10554

2E. Streamflow and Runoff

INFLUENCES OF RIVER FLOW ON THE DYNAMICS OF PHYTOPLANKTON PRODUCTION IN A PARTIALLY STRATIFIED ESTUARY,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 2L.
W89-10537

ROUGHNESS VALUES FOR OVERLAND FLOW IN SUBCATCHMENTS,
National Univ. of Singapore. Dept. of Civil Engineering.
S. Y. Liong, S. Selvalingam, and D. K. Brady.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 203-214, April 1989. 4 fig, 3 tab, 11 ref. National University of Singapore's Research Fund grant no. RP 98/83.

Descriptors: *Hydraulics, *Model studies, *Roughness coefficient, *Overland flow, *Hydraulic roughness, *Storm runoff, Kinematic wave theory, *Rainfall-runoff relationships, Land use, Hydrographs, Catchment areas, Mannings equation, Singapore, Calibrations.

A simple model is presented for assigning Manning roughness coefficients n to overland flow segments

in kinematic wave models. The resulting n-value for each subcatchment reflects its imperviousness and its land use. This approach has been incorporated into a kinematic wave model, and its application is demonstrated on a catchment in Singapore. One storm record was used for calibration purposes, and this yielded extreme Manning n-values of 0.02 and 0.30 for pure impervious and pervious sections, respectively. The calibrated model was then tested on two other storms for verification. Good agreements between simulated and measured hydrographs were obtained. (Author's abstract)
W89-10557

SLOPING CREST CRUMP WEIR,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-10559

CONTINUOUS DISTRIBUTED MODEL OF STORAGE DOMINATED WATERSHED RUNOFF,
California Univ., Los Angeles.
T. W. Cundy, and R. H. Hawkins.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 305-311, April 1989. 3 fig, 7 ref. EPA agreement CR813651-01-1.

Descriptors: *Runoff, *Model studies, *Watersheds, *Rainfall-runoff relationships, Water storage, Infiltration, Probability distribution, Small watersheds, Soil moisture retention, Statistical analysis.

A simple model of the rainfall-runoff response from spatially varied storage dominated watersheds was developed. The framework of the model is flexible in that it has previously been used to describe rate controlled watersheds. A major strength is that it leads to relatively simply explained relationships. However, only limited runoff attributes are described. The continuous infiltration-dependent analysis of Hawkins and Cundy and Boughton's discrete distributed storage model may be considered special cases of a single underlying model. A hillslope or a watershed can be considered an assemblage of elements whose array is described by a probability density function. While elements may be in any order along flow paths, there are two perfect orientations that envelope all possibilities. All random orientations must fall within these limits. Limited rainfall-runoff data from small watersheds suggests that the larger capacities are upslope and the low capacities downslope. An important potential contribution for this approach is the prediction of rainfall-runoff from ungaged basins. For such an application, a statistical characterization of either the steady state infiltration capacities or the soil moisture holding capacities is necessary. Recent work in texture-based prediction of such measures shows promise, although it appears that direct measurements may still be necessary for some parameters. (Miller-PTT)
W89-10564

EVIDENCE OF DARK AVOIDANCE BY PHOTOTROPHIC PERIPHYTIC DIATOMS IN LOTIC SYSTEMS,
National Hydrology Research Inst., Saskatoon (Saskatchewan). Aquatic Ecology Div.
For primary bibliographic entry see Field 2H.
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EFFECT OF CONCENTRATION BOUNDARY LAYER ON CARBON LIMITED ALGAL BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
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INVESTIGATIONS ON THE SEASONAL CHANGES IN THE CHEMICAL COMPOSITION OF LIVER AND CONDITION FROM A NEOTROPICAL CHARACOID FISH COLOSSOMA MACROPOMUM (SERRASALMIDAE),
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 2H.
W89-10596

TEMPORARY FAT STORAGE, AN ADAPTATION OF SOME FISH SPECIES TO THE WATER LEVEL FLUCTUATIONS AND RELATED ENVIRONMENTAL CHANGES OF THE AMAZON RIVER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W89-10597

HYDROGEOCHEMISTRY OF FRESHWATERS CROSSED BY THE TRANSAMAZON HIGHWAY, NORTHERN BRAZIL (HYDROGEOCHEMIE VON FLEISSGEWASSERN IM BEREICH DER TRANSAMAZONICA (NORDBRASILIEN),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
For primary bibliographic entry see Field 2K.
W89-10598

ECOLOGICAL ASPECTS OF THE FISH FAUNA OF THE MUCAJAI RIVER, IN THE PAREDAO ISLAND REGION, RORAIMA, BRAZIL (ASPECTOS ECOLOGICOS DA ICTIOFAUNA DO RIO MUCAJAI, NA AREA DA ILHA PAREDAO, RORAIMA, BRASIL),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
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MICROBIAL AND ANIMAL PROCESSING OF DETRITUS IN A WOODLAND STREAM,
Lund Univ. (Sweden). Stream and Bethic Ecology Group.
For primary bibliographic entry see Field 2H.
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EFFECTS OF FLOW REGIME AND CYPRINID PREDATION ON A HEADWATER STREAM,
North Dakota Univ., Grand Forks. Dept. of Biology.
For primary bibliographic entry see Field 2H.
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ROLE OF MACROINVERTEBRATES IN NITROGEN DYNAMICS OF A DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-10653

BRACKISH-WATER INVADERS IN THE RIVER RHINE: A BIOINDICATION FOR INCREASED SALINITY LEVEL OVER THE YEARS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5C.
W89-10658

CHIRONOMID MIDGES AS INDICATORS OF ORGANIC POLLUTION IN THE SCIOTO RIVER BASIN, OHIO,
Ohio Univ., Athens. Dept. of Zoological and Biomedical Sciences.
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W89-10666

RIVER PLANFORM FACIES MODELS: THE SEDIMENTOLOGY OF BRAIDED, WANDERING AND MEANDERING REACHES OF THE SQUAMISH RIVER, BRITISH COLUMBIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-10674

STATISTICAL ESTIMATION OF EXTREME FLOOD FLOWS USING CONFIDENCE INTERVALS,
Royal Inst. of Tech., Stockholm (Sweden).
E. Reinius.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 18-22, April 1989. 4 fig, 7 tab, 4 ref.

Descriptors: *Flood flow, *Flood data, *Frequency analysis, *Dam design, *Reservoir design, *Statistical analysis, Estimating, Maximum flow, Historic floods, Probability distribution, Design flow, Dam failure.

A statistical flood flow analysis is based on the assumption that the annual maximum flows are random variables from a stochastic hydrological process. Hence, one observed historical flow sequence is only one possible sequence of flow records from a population, and the parameters of the observed sequence would not be exactly equal to the population parameters. This article discusses methods for estimating the parameters from an observed sample of annual maximum flows, and methods are derived for determining the confidence interval. Applying the methods to an unregulated river, the probability that a flood flow of probability p and return interval 1/p should arise during a period of N years can be calculated. The distribution curve for m = 1 of a great number of samples of size N is obtained from (1-p) to the N power = 1-C where c = relative number of values with probability p. For a 200-year old dam, for example, there is a probability of 0.18 and 0.33 that a 1000-year or a 500-year flow, respectively, has occurred or been exceeded since the dam was built. One method to decrease the risks of extreme flood flows is to use low probability and the upper confidence limit for the determination of the design flow. For important dams and large reservoirs which would have catastrophic consequences in the event of a dam failure, the statistical calculation of extreme floods could be supplemented by a calculation of the probable maximum flood, based on hydrographs of extreme rainfalls and snow melting, and taking into account possible changes in drainage conditions. (Sand-PTT)
W89-10687

RATES AND PROCESSES OF CHANNEL DEVELOPMENT AND RECOVERY FOLLOWING THE 1980 ERUPTION OF MOUNT ST. HELENS, WASHINGTON,
Cascades Volcano Observatory, Vancouver, WA.
For primary bibliographic entry see Field 2J.
W89-10758

SIMPLE PARAMETER-FREE FLOOD MAGNITUDE ESTIMATOR,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 129-137, April 1989. 6 tab, 11 ref.

Descriptors: *Model studies, *Flood forecasting, *Simulation, *Flood discharge, *Mathematical studies, *Maximum probable floods, Estimators, Design floods, Gumbell-kernel estimator, Flood data, Frequency distribution, Nonparametric methods.

Flood magnitudes were simulated using the nonparametric Gumbell-kernel (or G-k) flood magnitude estimator. The estimated 50-yr flood magnitude is obtained by finding the value of x (maximum flood) which gives p (probability) = 0.98. A unique solution can always be obtained by simple numerical methods such as bisection. Root-mean-square values and popbabilities of an underestimate were tabulated with respect to samples of size 20, 30, and 50 from a selection of 'floodlike' distributions. Besides indicating the region of applicability of the estimator, the tabulated results provide a useful basis for measuring the improvement of future parameter-free estimates. The following properties are suggested as being 'practically desirable' for any flood estimator: (1) distribution-free; (2) median-unbiased; (3) small estimation error, and

(d) capable of yielding an indication of the estimation error. The G-k estimator satisfies points (1) and (2) reasonably well, whereas (3) can be judged only against other non-parametric estimators. The question of estimation error is a difficult problem when estimating the higher quantiles of an unknown distribution. (Rochester-PTT)
W89-10759

EFFECT OF CHOICE OF ROUTING MODEL ON EXTREME FLOW STATISTICS,
Polish Academy of Sciencce, Warsaw. Inst. of Geophysics.
Z. W. Kundzewicz, and E. J. Plate.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 139-156, April 1989. 7 fig, 2 tab, 14ref.

Descriptors: *Statistics, *Flood routing, *Mathematical studies, *Model studies, *Kalinin-Milyukov model, *St Venant equations, Maximum probable floods, Design floods, Standards, Errors.

The tradeoff between complexity and accuracy of flood routing models and methods of determination of extreme flow statistics are considered. A system is analyzed consisting of a channel reach with a set of input flood waves that are routed through the reach using a flood routing method. The consequences for design are determined of the error introduced if, instead of the complete St. Venant (SV) equations, the Kalinin-Milyukov (KM) model is used to calculate the outflow from the reach. This problem is investigated here in an example. As a standard, the routing by the complete SV equations is used. Use of the linear KM method introduces an error compared to the complete SV equations that is smaller than the uncertainty caused by the choice of extreme value distribution. As a consequence, the results of the KM method are found to be as acceptable for design as the results obtained from the SV equations. (Author's abstract)
W89-10760

PREDICTING THE MEAN ANNUAL FLOOD AND FLOOD QUANTILES FOR UNGAUGED CATCHMENT IN GREECE,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou, and J. Gordios.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 169-184, April 1989. 2 fig, 4 tab, 17 ref.

Descriptors: *Greece, *Flood forecasting, *Model studies, Multiple regression, Maximum probable floods, Design floods, Catchment areas, Prediction, Hydrology.

The spatial variation of the mean annual flood of both mean daily and instantaneous extremes and of the parameters of the Extreme Value Type 1 (EV1) distribution for catchments in the northwest and west regions of Greece are explained largely in terms of physiographic and climatological characteristics of the catchments by using multiple regression techniques. The following catchment characteristics were employed: drainage area, mean annual areal precipitation, stream frequency, main stream slope and length, intensity of the one-day rainfall of 5-yr return period, and a soil type index. The EV1 distribution has been found to describe adequately the annual frequency distributions of the daily and of the standardized-by-their-mean-value daily extremes of the catchments. Based on the regional models of the parameters of the distribution, annual flood frequency curves (and thus flood quantiles of the assumed distribution) can be derived. The developed regional models have been used successfully in predicting with satisfactory accuracy the mean annual floods and flood quantiles needed in hydrological design for ungauged catchments within the region studied. (Rochester-PTT)
W89-10762

ENCRUSTING ALGAL ASSEMBLAGES IN A MEDITERRANEAN RIVER BASIN,
Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W89-10786

ENVIRONMENTAL STRESS IN FIVE AQUATIC ECOSYSTEMS IN THE FLOODPLAIN OF THE RIVER RHINE,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
For primary bibliographic entry see Field 5C.
W89-10796

SPATIAL VARIATIONS AND CORRELATIONS IN THE DISTRIBUTION OF PCDDS, PCDFS AND RELATED COMPOUNDS IN SEDIMENTS FROM THE RIVER RHINE-WESTERN EUROPE,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
For primary bibliographic entry see Field 5B.
W89-10809

BINDING OF THREE PCB CONGENERS TO DISSOLVED ORGANIC CARBON IN FRESHWATERS,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W89-10810

DETERMINATION OF THE CRITICAL LOCATIONS IN A STOCHASTIC STREAM ENVIRONMENT,
Wyoming Water Research Center, Laramie.
For primary bibliographic entry see Field 5G.
W89-10822

COPPER IN THE FLY RIVER SYSTEM (PAPUA NEW GUINEA) AS INFLUENCED BY DISCHARGES OF MINE RESIDUE: OVERVIEW OF THE STUDY AND PRELIMINARY FINDINGS,
Institute for Soil Fertility, Haren (Netherlands).
For primary bibliographic entry see Field 5B.
W89-10832

COMPOSITION AND DISTRIBUTION OF THE MACROZOOBENTHOS OF THE RIVER STRUMA (C'STAV I RAZPREDELENIE NA MAKROZEESBENTOSA),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 2H.
W89-10855

QUALITATIVE APPRAISAL OF THE HYDROLOGY OF THE YEMEN ARAB REPUBLIC FROM LANDSAT IMAGES,
For primary bibliographic entry see Field 7C.
W89-10941

WATER QUALITY OF NORTH CAROLINA STREAMS,
For primary bibliographic entry see Field 5B.
W89-10942

PROGRAM FOR EVALUATING STREAM QUALITY IN NORTH CAROLINA,
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W89-10943

WATER QUALITY OF THE YADKIN-PEE DEE RIVER SYSTEM, NORTH CAROLINA-VARIABILITY, POLLUTION LOADS, AND LONG TERM TRENDS,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-10947

HYDROLOGY AND ECOLOGY OF THE APALACHICOLA RIVER, FLORIDA: A SUMMARY OF THE RIVER QUALITY ASSESSMENT,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-10948

INTERIM REPORT ON 1985-86 HIGH WATER LEVELS IN THE GREAT LAKES-ST. LAWRENCE RIVER BASIN.
International Joint Commission-United States and Canada, Washington, DC.
International Joint Commission, October 1988. 27p, 11 tab, append.

Descriptors: *Water level fluctuations, *Great Lakes, *St. Lawrence River, *Management planning, *Flood plain management, Water level, Precipitation, Rainfall intensity, Economic aspects, Coastal zone management, Water management.

On August 1, 1986 the Governments of Canada and the United States, in response to record high water level conditions occurring in the Great Lakes, referred the problem of fluctuating Great Lakes water levels to the International Joint Commission (IJC) for examination and report. As part of this effort, the Government asked for an interim report focusing on measures to alleviate the high water level crisis existing at that time. To obtain the additional information for its consideration of an interim report, the Commission decided in September 1986 to use a Task Force approach with membership composed of IJC staff and specialists from both countries. Eight major tasks were identified and subgroups established to develop detailed work plans and undertake the technical evaluations. Complete descriptions of the various measures, with their limitations and constraints, appear in the individual task reports that have been made available previously. Conclusions include: (1) the high lake level crisis, that began and continued until early 1987, no longer exist; (2) fluctuating lake levels are, for most observers, the tangible evidence of variations, primarily in precipitation (rainfall and snowfall) and secondarily in evaporation, that are created by unpredictable weather patterns; (3) it is impossible to predict the occurrence (when), the type (above or below average), the duration (length of time), or the intensity (how far above or below average), of a future trend in precipitation), it is impossible to predict its duration or intensity; (4) under present climatic conditions, it should be assumed that extreme lake levels will occur at irregular intervals and may occur at any point in time; (5) the Task Force found that a combination of relatively low capital cost measures, utilizing primarily existing facilities and operated as part of a Great Lakes Basin emergency high water management plan, could be implemented within one year and could lower extreme high water levels; and (6) the implementation of an emergency high-water or low-water management plan requires agreements between the Governments, and coordination among the various entities that have the operational responsibility for each individual component. (Lantz-PTT)
W89-10954

ESTIMATING PEAK DISCHARGES OF SMALL, RURAL STREAMS IN MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
S. W. Wandle.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2214, 1983. 26p, 8 fig, 10 tab, 31 ref.

Descriptors: *Flood peak, *Streams, *Massachusetts, *Mathematical studies, Flood forecasting, Regression analysis, Flood frequency, Statistical analysis, Infiltration, Floods, Flood plain management.

Floodflows on natural-flow streams in Massachusetts with drainage areas between 0.25 sq mi and 260 sq mi may be estimated from drainage area, main channel slope, mean basin elevation, and the area of swamps, lakes, and ponds. Multiple regression techniques were used to define the relationship between a suite of basin and climatic characteristics and flood peaks in three flood frequency regions at a total of 95 sites. Regression equations for estimation of peak discharges for 0.5, 0.2, 0.1, 0.04, 0.02, and 0.01 exceedance probabilities are provided for ungaged sites. An improved sample

of flood peaks and gaging stations and the definition of three flood frequency regions reduced the standard errors of estimate by 5% over those for the 1977 relations. The equations are applicable to streams unaffected by regulation where the usable manmade storage is < 4.5 million cu ft/sq mi or by diversions or urbanization. The equations are restricted to sites where the basin indices are within a specified range outside of eastern Plymouth, Barnstable, Dukes, or Nantucket Counties. In these areas, the available data do not adequately define the influence of high infiltration and storage capacities of drainage basins on floodflows. (Lantz-PTT)
W89-10955

FLOODS OF OCTOBER 1977 IN SOUTHERN ARIZONA AND MARCH 1978 IN CENTRAL ARIZONA,
Geological Survey, Menlo Park, CA.
B. N. Aldridge, and J. H. Eychaner.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2223, 1984. 143p, 18 fig, 13 tab, 6 plates, 41 ref.

Descriptors: *Floods, *Historic floods, *Arizona, Santa Cruz River, Rainfall, Salt River, Flood damage, Flooding, Gila River, Verde River, Reservoir storage, Flood peak.

Major floods occurred in October 1977 and March 1978 in Arizona. As much as 14 in. of rain fell during October 6-9, 1977, over the mountains of southern Arizona and northern Mexico resulting in the highest discharge since at least 1892 on the Santa Cruz River upstream from Tucson. The flood inundated areas as much as 4 mi wide, covered at least 16,000 acres of farmland, and caused $15.2 million in damage. Residential losses occurred at Nogales, Amado, Green Valley, and Sahuarita. Widespread rainfall of 3 to 6 in. and 9 to 14 in. in some areas in the central mountains during February 27 to March 3, 1978, caused the highest discharge since 1920 on the Salt River in Phoenix and resulted in three deaths. Flooding along the Salt and Gila Rivers and several lesser streams caused statewide damage totaling $65.9 million. During the flood of March 1978, moderate peak discharges and unusually high volumes of runoff occurred on tributaries to the Salt and Verde Rivers upstream from a system of reservoirs. The reservoirs stored large quantities of water and greatly reduced the magnitude of the flood. The peak discharge of the Salt River was 125,000 cu ft/sec below Granite Reef Dam, and 122,000 cu ft/sec at Phoenix. Without the storage provided by the reservoirs, the peak discharge on the Salt River would have been 260,000 cu ft/sec and the discharge would have exceeded 100,000 cu ft/sec for 66 hr. The Verde River was the principal flood source, but flows at the upstream gaging stations did not indicate the magnitude of the impending flood at Horseshoe Reservoir because large inflow from tributaries immediately upstream from the reservoir caused the river to rise at downstream stations before it rose at upstream stations. (Lantz-PTT)
W89-10958

APPLIED HYDROLOGY,
Illinois Univ. at Urbana-Champaign. Hydrosystems Lab.
V. T. Chow, D. R. Maidment, and L. W. Mays.
McGraw-Hill Book Co., New York. 1988. 572 p.

Descriptors: *Rainfall-runoff relationships, *Surface water, *Hydrology, *Hydrologic systems, Fluid mechanics, Groundwater, Hydrologic cycle, Precipitation, Flow profiles, Floods, Runoff, Hydrologic models.

Surface water hydrology is the focus of this book which is presented in three sections: hydrologic processes, hydrologic analysis, and hydrologic design. Hydrologic processes are covered in Chapters 1 to 6, which describe the scientific principles governing hydrologic phenomena. The hydrologic system is visualized as a generalized control volume, and the Reynold's Transport Theorem (or general control volume equation) from fluid mechanics is used to apply the physical laws governing mass, momentum, and energy to the flow of atmospheric water, subsurface water, and surface water. This section is completed by a chapter on hydrologic measurement. Hydrologic analysis is treated in the next six chapters (7 to 12), which emphasize computational methods in hydrology for specific tasks such as rainfall-runoff modeling, flow routing, and analysis of extreme events. These chapters are organized in a sequence according to the way the analysis treats the space and time variability and the randomness of the hydrologic system behavior. Special attention is given in Chapters 9 and 10 to the subject of flow routing by the dynamic wave method where the recent availability of standardized computer programs has made possible the general application of this method. Hydrologic design is presented in the final three chapters (13 to 15), which focus on the risks inherent in hydrologic design, the selection of design storms including probable maximum precipitation, and the calculation of design flows for various problems including the design of storm sewers, flood control works, and water supply reservoirs. (Lantz-PTT)
W89-10963

SELECTIVE LUMPING EFFECTS ON DEPTH-INTEGRATED FINITE ELEMENT MODEL OF CHANNEL FLOW,
Mississippi Univ., University. Dept. of Mechanical Engineering.
J. Yue.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 119-129, 6 fig, 7 ref.

Descriptors: *Statistical methods, *Model studies, *Channel flow, *Finite element method, *Mathematical models, Eddies, Flow velocity, Numerical analysis, Chezy equation, Model testing, Viscosity.

In applying the depth-integrated finite element model to solve river and basin water flow problems, matrix lumping techniques are widely employed for the benefits of eliminating matrix inversion and economizing computing time. The possible effects introduced by lumping simplification cause concern in engineering applications. A comparison was made of the lumped scheme with the unlumped model and the theoretic solution. The effects introduced by the lumping scheme were investigated. These effects include the influence of the selective lumping parameter on stability, numerical damping, Chezy coefficient, and eddy viscosity. It was found that the lumping scheme not only simplifies solution procedure and saves computing time, but also improves stability. The numerical damping effect is negligible for a much larger range of choice of the selective lumping parameter and the simple lumping scheme gives a better simulation of the theoretic solution than the unlumped model. (See also W89-11016) (Author's abstract)
W89-11026

EFFECT OF DATA ERRORS IN THE OPTIMIZATION OF THE SAINT-VENANT FLOOD ROUTING EQUATIONS,
Queen Mary Coll., London (England).
R. Haghi-Khatibi, J. J. R. Williams, and P. R. Wormleaton.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 219-230, 8 fig, 5 ref.

Descriptors: *Error analysis, *Mathematical studies, *Optimization, *Data interpretation, *Flood routing, *Open-channel flow, Errors, Friction, Mathematical equations, Channel flow, Flow system.

The effects of unreliable input data on the value of the identified roughness parameters and upon the performance of gradually varied flow equations was investigated. Errors due to discretization and data were isolated and analyzed. Results show that the choice of objective function is of paramount importance in river optimization work. The use of normalized objective functions, as defined in this paper, have been shown to lead to significantly biased results, even when the level of noise in the data is fairly low. It is therefore recommended that, when carrying out friction parameter optimization in open channels using a minimization of error squared criterion, the errors are simply formed as the difference between calculated and observed values. If a normalized expression is required, then the differences should be divided by a constant value (i.e. hydrograph mean), rather than the current depth or discharge, whether calculated or observed. (See also W89-11033) (Friedmann-PTT)
W89-11049

FLOODS IN THE BRAHMANI DELTA IN ORISSA, INDIA,
Hydraulic Study Dept., Calcutta Port Trust, Calcutta, India.
A. K. Chatterjee.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 253-262, 4 fig.

Descriptors: *Floods, *Model studies, *India, *Computer models, *Deltas, *Flood discharge, *Hydrologic models, Flood profiles, Model studies, Flood basins, Storm surges, Monsoons, Finite difference methods, Flood protection, Flood peak, Mathematical equatons.

Aspects of the flood history of the Orissa Delta, India are reviewed. The delta is part of the Brahmani river system, and is a fertile alluvial network on the east coast emptying into the Bay of Bengal. A one-dimensional non-linear numerical model of the network was developed, based on the implicit finite difference technique of solving the system of two non-linear hyperbolic partial differential equations using unequal space grids. The model was calibrated with pre-monsoon discharge data in all the network branches. Before the estimation of the high flood levels, the positions of the double embankments were fixed on the survey charts. The model was run with an equivalent surge height of 3 m along with the maximum spring tide with range 2 m, as the downstream boundary conditions. The model results are now being implemented in the construction of double embankments along the Brahmani network. (See also W89-11033) (Friedmann-PTT)
W89-11052

IMPLICIT STRAIGHT CHARACTERISTIC METHOD TO SOLVE DIRECT AND INVERSE FLOOD ROUTING PROBLEMS,
Hydraulic Dept., Civil Engineering School Jordi Girona Salgado, 31-08034, Barcelona, Spain.
M. Gomez, J. Dolz, and L. Berga.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 263-273, 9 fig, 4 tab, 7 ref.

Descriptors: *Flood routing, *Irrigation canals, *Conveyance structures, *Model studies, *Urban drainage, Hyraulic properties, Networks, Computer models, Critical flow, Storm surge, Rainfall impact, Flow characteristics, Hydraulic engineering, Numerical analysis, Channels.

Transients in channel networks are one of the problems that hydraulic engineers face in many fields. Urban drainage networks or irrigation canals are common works, and transients produced by storm rainfalls, etc., are unusual in their operation, and supercritical flow could be created, a type of flow that has their special features. The studies carried out focused on numerical analysis, and an implicit straight characteristic method has been developed. If the usual explicit characteristic method assumes a straight characteristic line, with the slope of the line that of the initial point at time t(n), the scheme developed assumes a straight line as well, but with the slope of the final point at time

t(N+1). The operation with the scheme is easy, although it is implicit, and each point can be solved by a simple iterative method in a few steps. The scheme showed interesting properties. Supercritical flow that usually produces some problems when numerical models are used, was evaluated to test the scheme in front of others. Thus, explicit characteristic method showed volume error of about 20-30%. Implicit straight characteristic scheme showed volume error of no more than 1.2%, even with spatial discretization of 300 m. Computer time was very similar in both cases, although explicit method was faster. The scheme is well designed to calculate the inverse problems in an explicit way. (See also W89-11033) (Author's abstract)
W89-11053

STUDIES ON ROUTING OF FLOODS IN EPHEMERAL CHANNELS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
M. Nouh.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 287-299, 6 tab, 10 ref.

Descriptors: *Ephemeral streams, *Flood routing, *Saudi Arabia, *Channel flow, Mathematical studies, Flood peak, Discharge hydrographs, Errors, Parameterization, Mathematical equations, Floods, Statistical analysis, Comparison studies.

The relative accuracy of five methods of flood routing is examined using real inflow-outflow data from typical ephemeral channels in Saudi Arabia. The methods are the linear and the nonlinear Muskingum methods, the linear diffusion method, the variable parameter diffusion method, and the explicit leapfrog method for solving the full Saint-Venant equations for gradually varying flow in open channels. Four error parameters are used to compare the predicted with the recorded discharge hydrographs. These are the percentage error in the peak attenuation, the percentage error in the speed of the flood peak, the percentage standard deviation, and the percentage mean deviation. The results call for a strategy for selecting the most suitable flood routing method to be used in ephemeral channels under given conditions. The explicit leapfrog method produces accurate results, especially in channel reaches of small flood plain area, or when the shape of hydrograph is needed for design of large projects. Use of the linear Muskingum method is more accurate than the nonlinear Muskingum method, as it produces, in ephemeral channel reaches, results of reasonable accuracy compared to the results of the complicated numerical methods. Because of its simplicity, it is recommended for use after calibration for design of moderate projects, when initial estimate for floods is needed or when only the peak discharge is needed. (See also W89-11033) (Friedmann-PTT)
W89-11055

FINITE ELEMENT TWO-DIMENSIONAL MODEL FOR FREE SURFACE FLOWS: VERIFICATION AGAINST EXPERIMENTAL DATA FOR THE PROBLEM OF THE EMPTYING OF A RESERVOIR DUE TO DAM-BREAKING,
Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica.
A. Di Monaco, and P. Molinaro.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 301-312, 6 fig, 12 ref.

Descriptors: *Finite element method, *Mathematical models, *Flood waves, *Model testing, *Surface flow, *Dam failure, Dam stability, *Reservoir releases, Hydraulic properties, Wave propagation, Wave runup, Dams, Surface water, Flood forecasting, Hydraulic models.

The problem of the evaluation of the effects caused by the breaking of a dam has attracted much attention in recent years. Mathematical models have been used to deal with the problem. A one-dimensional schematization of the dam-break wave is generally assumed when the valley is very long and narrow. On the other hand, when the valley widens considerably downstream of the dam, and consequently large areas are flooded, a two-dimensional schematization is called for. Also, the propagation of the negative wave in a nearly circular-shaped reservoir must be carried out by means of a two-dimensional model if accurate results are needed. A two-dimensional free-surface flow model is developed, based on the finite element method for the space discretization and on an implicit one-step difference scheme for the time integration. Though good results were obtained when the model was applied to a prismatic channel, which is a one-dimensional problem, the capability of the model to cope with real two-dimensional dam-break wave propagation on dry beds has yet to be proved. The choice of initial conditions greatly influenced the accuracy and convergence of the model. Starting the computation from an already developed dam-break wave, derived from the proper analytical solution, proved to be the most suitable choice. (See also W89-11033) (Friedmann-PTT)
W89-11056

NUMERICAL MODELING OF DAM-BREAK FLOOD FORECASTING WAVE,
Institute of Technology, Baghdad (Iraq). Dept. of Irrigation.
S. M. Abdul-Salam.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 313-323, 4 fig, 5 tab, 3 ref.

Descriptors: *Mathematical models, *Wave propagation, *Flood waves, *Flood forecasting, *Dam failure, *Floodwater, *Runoff, Spillways, Dams, Dam stability, Hydraulic models, Computer models, Reservoirs, Safety, Seepage, Hydraulic structures.

Dam failure modeling is of vital importance in delineating areas endangered by dam break flood waters. Usually, the response time available for warning is much shorter than for precipitation runoff floods. Dam failures are often caused by overtopping of the dam due to inadequate spillway capacity during large inflows to the reservoir from heavy precipitation runoff. Dam failure may also be caused by seepage or piping through the dam or along internal conduits, or by earthquake damage. A simplified dam-break model is presented, which can be simulated by using the desk-top computer or by mainframe computers to predict downstream flooding produced by a dam failure. A simplified dam-break model is simulated for use as a powerful tool in giving advance warning to the public of downstream flooding areas endangered by the dam failure. The model is designed for interactive use, i.e. the computer asks for detailed information about the dam, reservoir, and downstream channel properties and the data must be entered with the appropriate values. When it was applied to a simple failure of the Teton dam, the results showed the model to be very useful and advantageous in finding the results of a dam-break problem in a very short time. (See also W89-11033) (Author's abstract)
W89-11057

COMPUTER-BASED METHODOLOGY TO DEVELOP THE ECONOMICS OF ENVIRONMENTAL CHANGE WITHIN RIVER-ESTUARY-COASTAL SYSTEMS,
Old Dominion Univ., Norfolk, VA. Coastal Engineering Inst.
For primary bibliographic entry see Field 2L.
W89-11062

DRY BEDS AND SMALL DEPTHS IN 2-D CODES FOR COASTAL AND RIVER ENGINEERING,
Grenoble-1 Univ. (France). Centre de Recherche et d'Essais de Machines Hydrauliques.
For primary bibliographic entry see Field 2L.
W89-11064

NUMERICAL PREDICTION OF THE EFFECT OF WATER ABSTRACTION UPON TIDAL CHARACTERISTICS OF THE MEGHNA DELTA,
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 2L.
W89-11066

PHYTOPLANKTON DYNAMICS OF THE FRESH, TIDAL POTOMAC RIVER, MARYLAND, FOR THE SUMMERS OF 1979 TO 1981: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
For primary bibliographic entry see Field 2H.
W89-11068

LOADS OF SUSPENDED SEDIMENT AND NUTRIENTS FROM LOCAL NONPOINT SOURCES TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
Geological Survey, Reston, VA.
R. E. Hickman.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2234-G, 1987. 35p, 14 fig, 30 tab, 42 ref.

Descriptors: *Sediment load, *Nutrients, *Suspended sediments, *Tidal rivers, *Potomac River, *Maryland, *Virginia, *Water quality, *Estuaries, Phosphorus, Nitrogen, Biochemical oxygen demand, Silica, Urban watersheds, Sediment yield, Sediment discharge, Streamflow.

Loads of suspended sediment, phosphorus, nitrogen, biochemical oxygen demand, and dissolved silica discharged to the tidal Potomac River and Estuary during the 1979-81 water years from three local nonpoint sources have been calculated. Average annual yields of substances leaving three urban watersheds (Rock Creek and the Northwest and Northeast Branches of the Anacostia River) and the rural Saint Clements Creek watershed were calculated. Yields calculated for the 1979-81 water years are up to 2.3 times period-of-record yields because of greater than average streamflow and stormflow during this 3-year period. The yields from the urban watersheds are 17%-51% of yields calculated using sediment concentration data collected during the 1960-62 water years. Loads discharged from all local tributary watersheds to the tidal Potomac River and Estuary during the 1979-81 water years were calculated by applying to the unsampled watersheds the yields determined for the monitored watersheds. The resulting loads are 2.7 million megagrams of suspended sediment, 3,100 megagrams of phosphorus, 14,000 megagrams of nitrogen, 74,000 megagrams of ultimate biochemical oxygen demand, and 68,000 megagrams of dissolved silica. The value for the load of sediment is probably an overestimate because the sediment yield calculated for the Saint Clements Creek watershed does not appear to be representative of rural watersheds. Summed, the loads discharged from all local nonpoint sources to the tidal Potomac River and Estuary during the 1979-81 water years accounted for 17%-38% of the loads discharged by major sources during this period. (See also W89-11068) (Lantz-PTT)
W89-11069

2F. Groundwater

NEW DRAIN FLOW FORMULA,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
J. C. Miles, and K. Kitmitto.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 215-230, April 1989. 12 fig, 3 tab, 16 ref, 3 append.

Descriptors: *Subsurface drainage, *Groundwater movement, *Hydraulics, *Drains, *Model studies, Flow, Mathematical models, Equations, Groundwater, Vertical flow, Comparison studies, Water table, Performance evaluation, Anisotropy, Heterogeneity.

Two alternative methods (Hooghoudt's and Herbert's) of representing the flow of water to drains, using groundwater flow equations which do not explicitly represent vertical flows, have been compared by using them in numerical groundwater flow models. The accuracy of both methods has been checked by means of a further numerical model which incorporates vertical flow. Flows through several types of media have been examined and results presented for both flows to a drain and heads midway between the drains, the latter being the maximum head value. The general conclusion that can be drawn is that, Hooghoudt's method is known to be accurate within certain limits, the methods give results of acceptable accuracy. For homogeneous media, but the results for layered media show that it can easily be extended to such flow problems. Herbert's method gives results of comparable accuracy to Hooghoudt's method and has the advantage of being applicable to anisotropic media. The results show that flows can be accurately calculated and also that the single depth integrated potential midway between the drains is a good assessment of the height of the water table. The limitations on the applicability of Hooghoudt's and Herbert's methods seem to be due rather to the limitations imposed by single depth integrated potential rather than the methods themselves. There is little to choose between Herbert's method and that of Hooghoudt. When one considers the approximation involved in both, then the degree of accuracy that can be achieved is remarkabe, and some of the limitations can easily be overcome by use of the multi-layered models. (Miller-PTT)
W89-10558

INHIBITORY SUBSTRATE UTILIZATION BY STEADY-STATE BIOFILMS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W89-10575

WATER LEAKAGE FROM LAKE CHUZENJI, NIKKO,
Utsunomiya Univ. (Japan). Faculty of Education.
For primary bibliographic entry see Field 2H.
W89-10605

RADON CONCENTRATION IN GROUND WATERS IN SOME AREAS OF GRANITE INTRUSION IN VARIOUS AGES,
Saga Univ. (Japan). Faculty of Science and Engineering.
For primary bibliographic entry see Field 2K.
W89-10607

INVESTIGATION OF FAILURE MECHANISMS AND MIGRATION OF ORGANIC CHEMICALS AT WILSONVILLE, ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W89-10680

USE OF ON-SITE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TO EVALUATE THE MAGNITUDE AND EXTENT OF ORGANIC CONTAMINANTS IN AQUIFERS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W89-10683

CRITIQUE OF THE HVORSLEV METHOD FOR SLUG TEST ANALYSIS: THE FULLY PENETRATING WELL,
Chirlin and Associates, Inc., Rockville, MD.
G. R. Chirlin.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 130-138, Spring 1989. 6 fig, 1 tab, 20 ref. Append.

Descriptors: *Test wells, *Fully penetrating wells, *Aquifer testing, *Pumping tests, *Groundwater, *Slug tests, *Hydraulic conductivity, Mathematical models, Wells, Aquifers.

The Hvorslev (1951) method of slug test analysis addresses a variety of well and aquifer geometries, is easy to apply, and is widely used. Its underlying mathematical model assumes negligible compressive storage (aquifer water and matrix are incompressible, flow is quasi-steady). The consequences of this assumption are explored for a particular case of a well fully penetrating a confined, radially infinite, homogeneous, isotropic aquifer. The Cooper (1967) model of this setting includes the effect of compressive storage and is otherwise identical to Hvorslev. Therefore, for this setting the performance of the Hvorslev method is gauged against that of the Cooper model. The original Hvorslev model is recast into conventional governing equations to facilitate the comparison with Cooper. The Hvorslev estimate of hydraulic conductivity for this setting is accurate only to within an order of magnitude, assuming no knowledge of the aquifer storage coefficient. Accuracy of the Hvorslev estimate depends on the normalized aquifer storage coefficient, on the matching procedure used to fit the Hvorslev model, and on the analyst's choice for the Hvorslev effective radius r sub e. The Hvorslev model provides no physical basis for selecting r sub e. Some insight is gained by viewing the constant head condition at radius r sub e as an 'infinite storage' at r sub e. Flow from this discrete storage approximates the distributed storage of a compressible aquifer. By reference to Cooper one can select a value of r sub e which leads to a correct Hvorslev estimate of hydraulic conductivity, given prior knowledge of the aquifer storage coefficient. For an example aquifer, the Hvorslev and Cooper models yield substantially different distributions of head within the aquifer. (Author's abstract)
W89-10684

FRACTURE EFFECTS IN THE SHALLOW GROUNDWATER ZONE IN WEATHERED SARNIA-AREA CLAY,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
A. Y. D'Astous, W. W. Ruland, J. R. G. Bruce, J. A. Cherry, and R. W. Gillham.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 43-56, February 1989. 11 fig, 2 tab, 31 ref.

Descriptors: *Fracture permeability, *Ontario, *Geohydrology, *Groundwater movement, *Clays, Water table fluctuations, Glacial drift, Hydraulic conductivity, Piezometers, Geologic fractures, Tracers, Tritium.

The Sarnia area of southwestern Ontario is underlain by thick deposits of clay-rich glacial till. From ground surface to between 4 and 6 m depth the clay till is fractured, oxidized, and penetrated by root holes. The water table fluctuates seasonally between the ground surface and the bottom of the weathered zone. Water-level response tests in conventional piezometers installed in augered holes in the weathered zone typically provide very low values of hydraulic conductivity (10 to the minus 7th power to 10 to the minus 9th power cm/sec), which are similar to values obtained from the deeper unweathered and unfractured till. The augering process creates a smeared clay zone along the borehole walls the significantly reduces measured hydraulic conductivity values. In this study, the weathered-zone hydraulic conductivity was measured using unconventional piezometers, a large-diameter well, and a trace experiment between two peat pits. The smeared zone was removed or reduced around these installations, and the measured weathered-zone hydraulic conductivity was 0.00001 to 10 to the minus 7th cm/sec, much higher than in the deep unweathered clay. These results, together with depth profiles of groundwater tritium and monitored water-level fluctuations, indicate that the weathered zone has hydraulic conductivity governed by fractures and has significant hydrologic activity in the fractures. (Author's abstract)
W89-10745

SETBACKS FROM THE CRESTS OF SLOPES ALONG THE NORTH SASKATCHEWAN RIVER, ALBERTA,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8E.
W89-10747

ORIGIN AND MOVEMENT OF GROUNDWATER AND MAJOR IONS IN A THICK DEPOSIT OF CHAMPLAIN SEA CLAY NEAR MONTREAL,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
D. E. Desauniers, and J. A. Cherry.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 80-89, February 1989. 8 fig, 2 tab, 45 ref.

Descriptors: *Waste disposal, *Quebec, *Groundwater movement, *Geohydrology, Clays, Ions, Sodium, Chlorides, Calcium, Magnesium, Potassium, Advection, Design criteria, Land use, Management planning, Paleooceanography.

At a site near Montreal (Quebec province, Canada), piezometers and core samples were used to assess the origin, age, and rate of groundwater movement in a 28-m thick deposit of Champlain Sea clay. Tritium occurs only within the upper 3-4 m, which indicates that the groundwater beneath this surficial weathered zone originated prior to 1952. Concentrations of 18O, Na(+), and Cl(-) in water from the deepest piezometer suggest that the deep clay was deposited in a mixture of about 33% seawater and about 67% freshwater. Profiles of several major ions show a gradual increase in concentration with depth. Mathematical simulations of vertical migration of Ca(2+), Mg(2+), K(+), Na(+), and Cl(-) provide close matches to the field profiles when only upward diffusion of these ions into the surficial freshwater zone in included in the model of diffusion time of approximately 10,000 yr. When the downward advection rate of 0.13 cm/yr obtained from field measurements of the hydraulic gradient and hydraulic conductivity is included in the model, the simulated major-ion profiles deviate markedly from the field profiles. This suggests that the hydraulic gradient in the clay is less than the threshold gradient necessary to cause Darcian flow. These results suggest that, in areas where clayey Champlain Sea deposits are thick, opportunities exist for locating waste disposal facilities that would have no significant potential for causing contamination of groundwater resources beneath the clay. (Author's abstract)
W89-10749

FAST TRACKING MILITARY WASTE,
Haley and Aldrich, Inc., Cambridge, MA.
For primary bibliographic entry see Field 5G.
W89-10817

HYDROGEOLOGY COMES TO THE SURFACE,
Harza Engineering Co., Chicago, IL.
K. Uhlman.
Civil Engineering CEWRA9, Vol. 59, No. 4, p 60-62, April 1989.

Descriptors: *Education, *Geohydrology, *Groundwater pollution, *Landfills, *Leaching, *Water quality management, Monitoring, Groundwater.

Engineers must understand hydrogeology to avoid unnecessary and expensive corrective actions, and also to avoid overlooking such potential pollution sources as unforeseen transport routes that lead hazardous wastes to groundwater supplies. Current environmental regulations are also forcing civil engineers to address hydrogeology; under current law, EPA regional administrators must consider 'hydrogeological characteristics of the facility and surrounding land' when establishing concentration

limits for hazardous waste facilities. Engineering and hydrogeology must be combined through teamwork to simplify tasks and avoid data misinterpretations. An example is given of a midwestern municipal solid waste landfill. Despite a sophisticated leachate collection system, boron was detected in a down-gradient monitoring well. The local regulatory agency considered this a leachate indicator and prepared to take corrective action. The landfill operator summoned hydrogeologists, who proved that the boron was a natural constituent of the subsurface, and that the landfill was safe. (Doria-PTT)
W89-10820

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: STEADY-STATE SOLUTIONS BY A FOURIER SINE TRANSFORM METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-10828

QUALITATIVE APPRAISAL OF THE HYDROLOGY OF THE YEMEN ARAB REPUBLIC FROM LANDSAT IMAGES,
For primary bibliographic entry see Field 7C.
W89-10941

CHLOROFORM CONTAMINATION IN PART OF THE ALLUVIAL AQUIFER, SOUTHWEST LOUISVILLE, KENTUCKY,
For primary bibliographic entry see Field 5B.
W89-10950

DIGITAL MODELS OF GROUND-WATER FLOW IN THE CAPE COD AQUIFER SYSTEM, MASSACHUSETTS,
J. H. Guswa, and D. R. LeBlanc.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2209, 1985. 112p, 60 fig, 12 tab, 17 ref.

Descriptors: *Massachusetts, *Mathematical models, *Groundwater movement, *Cape Cod, *Aquifer systems, Finite difference methods, Hydrologic models, Saline-freshwater interface, Mathematical studies, Flow velocity.

The Cape Cod aquifer system was simulated with three-dimensional finite-difference groundwater flow models. Five areas were modeled to provide tools that can be used to evaluate the hydrologic impacts of regional water development and waste disposal. The model boundaries were selected to represent the natural hydrologic boundaries of the aquifer. The boundary between fresh and saline groundwater was treated as an interface along which there is no dispersion. The saline water zone was treated as static. Comparisons of calculated and observed values of head, position of the boundary between fresh and saline water, and groundwater discharge indicate that the simulated groundwater reservoirs generally agree with field conditions. Model analyses indicate that the total steady state freshwater flow rate through the five modeled areas is approximately 412 cu ft/sec. (Author's abstract)
W89-10951

CONNECTOR WELL EXPERIMENT TO RECHARGE THE FLORIDAN AQUIFER, EAST ORANGE COUNTY, FLORIDA,
Geological Survey, Austin, TX.
For primary bibliographic entry see Field 4B.
W89-10952

PRELIMINARY EVALUATION OF GROUND-WATER CONTAMINATION BY COAL-TAR DERIVATIVES, ST. LOUIS PARK AREA, MINNESOTA,
Geological Survey, St. Paul, MN.
For primary bibliographic entry see Field 5B.
W89-10953

AVAILABILITY AND QUALITY OF WATER FROM THE DAKOTA AQUIFER, NORTHWEST IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
M. R. Burkart.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2215, 1984. 65p, 4 fig, 5 tab, 8 plates, 19 ref.

Descriptors: *Groundwater budget, *Groundwater quality, *Dakota Aquifer, *Iowa, Groundwater movement, Geohydrology, Groundwater potential, Radium, Groundwater recharge, Infiltration, Hydraulic conductivity.

The Dakota aquifer in northwest Iowa consists of sandstones in the Dakota Formation. It underlies most of the study area and is the most extensive source of groundwater in the area. Individual sandstone beds are from < 10 to >150 ft thick. The cumulative thickness of sandstone is > 200 ft throughout much of the area. Water flows through the aquifer from the north-central part of the study area to the east, south and southwest. Recharge is by infiltration from the land surface through the confining materials. Discharge is to underlying Paleozoic aquifers and to the alluvium and glacial outwash deposits along the Missouri and Big Sioux Rivers in the southwest part of the area. An average hydraulic conductivity of 40 ft/day was used to estimate the potential yield to wells completed in the aquifer. Yields of >250 gallons per minute (gpm) can be expected and >1,000 gpm could be produced in some areas. The water from the Dakota is a calcium, magnesium, sulfate type, and is suitable for irrigation. The concentration of radium-226 and other radionuclides exceeds recommended limits at several sites. The quality of water pumped from the aquifer may be altered by induced leakage from the underlying aquifers in Paleozoic age rocks if withdrawals reverse the pattern of natural flow from the Dakota into the Paleozoic aquifers. Evidence for such a reversal exists in the area around the city of LeMars. (Lantz-PTT)
W89-10956

SEWAGE PLUME IN A SAND AND GRAVEL AQUIFER, CAPE COD, MASSACHUSETTS,
For primary bibliographic entry see Field 5B.
W89-10957

KARST HYDROLOGY: WITH SPECIAL REFERENCE TO THE DINARIC KARST,
Split Univ. (Yugoslavia). Faculty of Civil Engineering Sciences.
For primary bibliographic entry see Field 2A.
W89-10961

GEOMORPHOLOGY AND HYDROLOGY OF KARST TERRAINS,
For primary bibliographic entry see Field 2J.
W89-10964

SELECTION CRITERIA FOR MATHEMATICAL MODELS USED IN EXPOSURE ASSESSMENTS: GROUND-WATER MODELS,
Environmental Protection Agency, Washington, DC. Office of Health and Environmental Assessment.
For primary bibliographic entry see Field 5G.
W89-10998

BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN UNCONSOLIDATED SURFICIAL MATERIALS AT THE U.S. DEPARTMENT OF ENERGY KANSAS CITY FACILITY,
UNC Geotech, Grand Junction, CO.
For primary bibliographic entry see Field 5A.
W89-10999

WELL DEVELOPMENT AND HYDRAULIC TESTING AT LLNL SITE 300: BUILDING 830, 834, 840 AND GSA AREAS.
Weiss Associates, Oakland, CA.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-009070. Price codes: A04 in paper copy, A01 in microfiche. Report No. UCRL-21010, March 1988. 66p, 3 fig, 4 tab, 12 ref, 2 append.

Descriptors: *Water supply development, *Pumping tests, *Wells, *Groundwater movement, Groundwater management, Turbidity, Monitoring, Hydraulic conductivity, Geohydrology, Flow rates, Groundwater quality, Observation wells, Perched groundwater, Geologic fractures, Mapping.

Well development was conducted on 17 monitoring wells in the southeast part of Lawrence Livermore National Laboratory (LLNL) Site 300. Seven wells exhibited some increase in flow or recovery rates, and most wells showed some decrease in water turbidity and/or sediment content. Further development of these wells would probably not significantly increase well yields. Hydraulic testing was performed on 19 monitor wells in the southeast part of Site 300. Seventeen of the wells were successfully tested using constant-discharge pumping tests or slug tests. Hydraulic conductivity ranged from 0.04 to 94 gallons per day (gpd)/sq ft. Hydraulic conductivity greatly varied with well location and screened depth, which is consistent with the fractured and heterogeneous geologic environment of the Site 300 area. Remediation by groundwater extraction does not appear feasible in the perched groundwater in the shallow alluvium, conglomerate, and sandstone of the Building 834 area. The wells within the sandstones of the General Services Area support moderate flow rates and may be suitable for groundwater extraction, if necessary. In general, the ability to support extractable flow rates is dependent on the locations and orientations of fractures, which are not presently known. Identifying fractures by surface mapping and exploratory drilling is recommended if groundwater extraction is described. However, identification of fracture orientation and spacing may be difficult and costly. (Lantz-PTT)
W89-11001

COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.
Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. 203p. Edited by D. Ouazar and C.A. Brebbia.

Descriptors: *Conferences, *Model studies, *Groundwater movement, *Aquifers, *Groundwater management, *Computer models, *Water resources development, Hydrologic models, Management planning, Simulation analysis, Finite element method, Case studies, Solute transport, Numerical analysis, Mathematical studies.

Advanced computational techniques are of permanent importance for the efficient utilization of water resources and are particularly useful to developing countries as they can provide a way of optimizing their resources. The First International Conference in Africa on Computer Methods and Water resources was convened in order to discuss these problems. The large response to the call for papers resulted in the compilation of six volumes of conference proceedings on the following topics: Vol. 1, Groundwater and Aquifer Modelling; Vol. 2, Computational Hydraulics; Vol. 3, Computational Hydrology; l Vol. 4, Computer Aided Engineering in Water Resources; Vol. 5, Computational Transport Phenomena; and Vol. 6, Water Quality, Planning and Management. Volume 1 provides a state of the art analysis on the numerical advances made in the simulation of problems related to groundwater and aquifer modelling, including new developments in finite elements, modelling using boundary elements and other analytical or semi-analytical techniques. Examples are discussed and case studies are presented throughout. This volume is of direct relevance to those engineers who are working on the applications of groundwater and aquifer modelling and need to keep abreast of new theoretical developments as well as the way in

which they are used in engineering practice. (See W89-11017 thru W89-11032) (Geiger-PTT)
W89-11016

GROUNDWATER MODELLING, THREE DIFFERENT APPLICATIONS OF A COMPUTER CODE FOR SIMULATION OF GROUNDWATER FLOW,
VBB/SWECO Consulting Group, Stockholm (Sweden).
A. Harlaut, and B. Sundloef.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 3-13, 6 fig, 2 ref.

Descriptors: *Computer programs, *Simulation, *Model studies, *Computer models, *Groundwater movement, *Finite element method, *Aquifers, Leakage, Sweden, Infiltration, Drainage area, Groundwater recharge, Permeability coefficient, Mathematical models, Design criteria, Water resources development.

The computer program AQUIFEM (A Finite Element Model for Aquifer evaluation) has been used in Sweden for over a decade to simulate confined or unconfined flow, leakage, infiltration, well-discharge, different boundary conditions, and other conditions related to groundwater movement. Three examples of different applications of the model are discussed to illustrate the wide range of calculation possibilities. During the construction of a large dam in northern Sweden the model was used to monitor the impoundment by comparison between calculated and observed water levels, to design drainage systems, and to calculate total leakage. During a pre-feasibility study for a canal in a desert area in Africa, questions arose about the consequences for the limited fresh groundwater resources. The model was used in this case for prognoses of the drainage effect both on the deep confined aquifer and the upper smaller unconfined systems to identify the least hazardous route for the canal. A large well field was proposed as a water supply for a factory in south-east Asia. The precipitation rate in the area was fairly well known and a suitable aquifer had been recognized by means of test drillings. Nothing was known about the recharge conditions, neither the direct infiltration in the unconfined areas, nor the rate of leakage in the confined parts of the system. By means of a careful calibration of an AQUIFEM model of the area both leakage and infiltration rates could be calculated. (See also W89-11016) (Geiger-PTT)
W89-11017

MODEL OF ALGERIAN-TUNISIAN CONTINENTAL INTERCONNECTING EXTENDED TO LIBYA (EXTENSION EN LIBYE DU MODELE DU CONTINENTAL INTERCALAIRE ALGERO-TUNISIEN),
Ecole Nationale des Ingenieurs de Tunis (Tunisia).
M. Besbes, and M. Zammouri.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 27-34, 2 fig, 7 ref. No English summary.

Descriptors: *Model studies, *Aquifers, *Hydrologic models, *Algeria, *Tunisia, *Libya, Mathematical models, Simulation analysis, Water resources development, United Nations.

At the time of the construction in 1972 of the UNESCO mathematical model for simulation of the Continental Interconnecting Aquifer, the Libyan part of the reservoir was ignored for lack of information. It may be supposed that there were certain quantitative imperfections in model predictions, particularly those concerning the southern Tunisian portion. As a consequence of the UNESCO model as well as another model constructed more recently in Libya and correspondingly ignorant of the Algerian/Tunisian part of the reservoir, the authors propose synthesis into a single Continental Interconnecting Aquifer model representing for the first time the combined territories of Algeria, Tunisia, and Libya over an area of 840,000 sq km. Utilizing the simulation approach as a tool, this model will, when completed, furnish somewhat more optimal results for southern Tunisia than obtained heretofore and will permit the development of 28,663 cu m/s of water supply by the year 2010. (See also W89-11016) (Author's Abstract)
W89-11018

PREDICTING REGIONAL GROUNDWATER LEVELS BY THREE-DIMENSIONAL NUMERICAL MODELS,
Padua Univ. (Italy).
For primary bibliographic entry see Field 4B.
W89-11020

FINITE ELEMENT SIMULATION OF THE HYDROTHERMAL BEHAVIOR OF AN ARTIFICIAL AQUIFER FOR SEASONAL ENERGY STORAGE,
Technische Hochschule Aachen (Germany, F.R.).
G. Rouve, H. Daniels, W. Pelka, E. Hahne, and N. Fisch.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 47-58, 4 fig, 8 ref.

Descriptors: *Simulation, *Hydrothermal studies, *Thermal properties, *Seasonal storage, *Model studies, *Energy storage, *Finite element method, *Artificial aquifers, Groundwater movement, Mathematical models, Numerical analysis, Porous media, Energy transfer, Model testing, Stratified flow, Thermal stratification, Gravel.

A mathematical-numerical procedure is being used to calculate changes in the temperature field with time in the Artificial Aquifer for thermal energy storage of the Stuttgart University. The procedure is based on the Finite Element Method and is able to simulate the behavior of the aquifer during charging and discharging, by exchanging water directly. When the aquifers' geometry was determined, the numerical model was used to evaluate the influence of different locations of the water inlet and outlet facilities as well as possible layering of the aquifer on the expected flow and temperature field. The final version of the aquifer called for gravel 16/32 mm in the charging and discharging layers and gravel 8/16 mm in the storage layer. A HDPE-liner is used to separate the reservoir from the surrounding soil. The bottom chamber of the central tube represents the cold water inlet/outlet. The hot water inlet/outlet is located in the charging layer at the outer boundary. Observation points are installed all over the artificial aquifer and in the surrounding soil in the three cross sections that diverge at an angle of 120 degrees. After validation of the finite element model against several field experiments, the experiments and the numerical model can be used to predict the behavior of new, larger artificial reservoirs for thermal energy storage. (See also W89-11016) (Geiger-PTT)
W89-11021

TWO-DIMENSIONAL FINITE ELEMENT MODEL FOR SOLUTE TRANSPORT IN MULTI-AQUIFER SYSTEMS,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
S. El Didy, and D. N. Contractor.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 59-69, 10 fig, 29 ref. DOE Contract No. DE-AC20-84LC11053.

Descriptors: *Model studies, *Finite element method, *Mathematical models, *Solute transport, *Path of pollutants, *Aquifer systems, Algorithms, Numerical analysis, Sorption, Advection, Coal gasification, Aquitards.

A two-dimensional, finite element program has been developed to study the movement of pollutants in multiple aquifer systems, in particular the distribution of the contaminants of combustion after long periods of time. Horizontal flow is assumed to occur in the aquifers, while vertical flow occurs through the aquitards. The mass transport equation takes into account advection, dispersion, decay, and sorption of the pollutant. Interactions between the aquifers is assumed to occur without decay or sorption of the pollutant as it travels through the aquitard. The Galerkin weighted-residual procedure is used to develop the element equations, and eight-noded isoparametric quadrilateral elements are used to discretize the aquifers. The global matrix consists of the nodal concentrations for all the aquifers in the system. The matrix is banded and is solved using the Gauss elimination algorithm. The numerical output of the program is validated, for accuracy, against analytic solutions for some one-dimensional mass transport problems. The program is used to study the movement of the pollutants away from the cavities created by underground coal gasification burns. (See also W89-11016) (Author's abstract)
W89-11022

TWO-DIMENSIONAL FINITE ELEMENT MODEL FOR WATER FLOW IN MULTI-AQUIFER SYSTEMS,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
S. El Didy, and D. N. Contractor.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 75-87, 10 fig, 1 tab, 29 ref.

Descriptors: *Finite element method, *Aquifer systems, *Aquitards, *Model studies, *Mathematical models, *Groundwater movement, Numerical analysis, Computer models, Coal gasification.

A two-dimensional finite element model has been developed for the simulation of water flow in a multi-aquifer system consisting of a number of aquifers separated by aquitards. Two-dimensional (x,y) flow is assumed to occur in the aquifers, with one-dimensional vertical flow occurring through the aquitards without any storage effect. The transient groundwater equation for horizontal flow in a single aquifer is expanded to include terms representing its interaction with adjacent aquifers. This equation is solved numerically using the finite element theory and the Galerkin weighted-residual method. Eight-noded isoparametric elements are used. Spatial numerical integration is performed using Gaussian Quadratures. A weighted finite difference scheme is used for time interaction. The program is written in FORTRAN V for the CDC CYBER175. It accepts different boundary and initial conditions for each aquifer. The output of this program gives the piezometric head and velocity components at each node in all aquifers and is used as input to a solute transport model for the same system and element network. The model was validated against several problems with simple geometry that have analytic solutions. The program is also applied to the flow problems associated with underground coal gasification burns, for which the program was primarily developed. (See also W89-11016) (Author's abstract)
W89-11023

FINITE ELEMENT MULTI-LAYER AQUIFER MODEL, 'FEMLAM',
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
A. H. M. Ghanem, A. M. Amer, and R. M. El-Damak.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 89-105, 4 fig, 12 ref.

Descriptors: *Model studies, *Aquifer systems, *Computer models, *Finite element method, *Groundwater movement, *Computer programs, Confined aquifers, Fortran, Model testing, Model studies, Mathematical models.

A number of computer codes have been published to simulate various kinds of groundwater management problems. The majority of these models simulate either one-layer or two-layer aquifer systems. A few of these models present aquifer systems consisting of more than two layers. All these models require a large computer core storage and big efforts to use. Personal computers (PC) have become a common tool for solving groundwater problems with less investment of time and effort. The literature shows that no attempt has been made to present a multi-layer aquifer model that could be coded on a PC. An attempt was made to develop such a model, to make it easy for PC-users to assess the various features of this kind of aquifers and to perform simulations in a simple and efficient way. To accomplish this objective a finite element multi-layer aquifer model (FEMLAM) has been developed. The FEMLAM is capable of simulating confined multi-layer aquifers in steady and transient conditions. The aquifer layers may be unisotropic and heterogeneous. Both steady and transient conditions can be simulated. FEMLAM can simulate head controlled and flow controlled boundaries as well as discharges from or to any layers. The values of boundary heads and discharges may vary with time for transient solutions. The testing of the model on hypothetical data of a five-layer aquifer is presented. FEMLAM is equipped with dynamic storage allocation to minimize storage requirements and to simplify the redimensioning of the program for a particular application according to the number of nodes and the number of layers. The model has been successfully coded in FORTRAN 77 for an IBM-PC having 640 KB core storage, of which only 115 KB are used, so that a large computer is not required. (See also W89-11016) (Author's abstract)
W89-11024

SIMULATION OF REGIONAL SUBSURFACE FLOW BY FINITE ELEMENT MODELS,
Padua Univ. (Italy). Inst. of Applied Mathematics.
G. Gambolati, G. Pini, and G. Verri.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 107-116, 8 fig, 1 tab, 8 ref.

Descriptors: *Regional planning, *Model studies, *Finite element method, *Simulation analysis, *Groundwater movement, *Mathematical models, *Aquifer systems, Numerical analysis, Groundwater management, Italy, Hydrologic data collections.

The numerical models represent very useful tools for the simulation of regional flows and may provide several indications as to a rational management and allocation of the available water resources. The very complex aquifer system underlying the Fruili-Venezia Giulia Region, northeastern Italy, has been analyzed with the aid of two combined models based on the finite element method. The first model simulates the steady flow in the Upper Plain and relies on the Dupuit-Forchheimer-Boussinesq approach. The second one simulates the multi-aquifer basin of the Lower Plain and is based on the integro-differential theory of flow. Both models have been run under a series of realistic assumptions properly combined with the limited available information. The results obtained for the dry regime are moderately satisfactory and allow for a first-hand appraisal of the quantity involved in the overall region groundwater balance. They also point out the need for a substantial improvement of the quality and quantity of the regional subsurface data vis a vis reliable future predictions in a wider framework of practical interest. (See also W89-11016) (Author's abstract)
W89-11025

NUMERICAL SIMULATION OF TRANSIENT UNCONFINED SEEPAGE PROBLEMS,
Liege Univ. (Belgium).
R. Charlier, J. P. Radu, and A. Dassargues.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 143-155, 8 fig, 16 ref.

Descriptors: *Simulation, *Model studies, *Finite element method, *Aquifers, *Seepage, *Mathematical models, Darcy's law, Water table fluctuations, Drinking water, Belgium, Groundwater movement, Transition flow, Soil water, Water pressure, Aquifers, Numerical analysis.

The finite elements modeling of transient unconfined aquifers was examined to better manage drinking water supplies for large towns such as Liege, Belgium. The transient nature of water table fluctuations are linked to the storage capacity in soil pores. The rainfall supply of the aquifer, the water outlet at rivers, and the water collecting methods are also time dependent. The geometry of the aquifer's geological layers may be complex with varying permeabilities and storage coefficients in each layer. Imposed potential, imposed pressure and impermeable limits exist; they are sinuous. Faults and dry valleys significantly modify the water flow. Water collection is done through wells or collecting galleries. The Darcy's laws for flow in confined and unconfined aquifers are reviewed, along with the numerical code modeling seepage and flow equilibrium by the virtual power principle. Using the virtual power equations, isoparametric finite elements can be built and implemented in a classical finite elements code (LAGAMINE code). Time stepping and integration and the iteration technique are used for even better approximations of flow conditions. Computations of a water table in a vertical plane soil area were made by the proposed numerical code and compared well with those computed by Piette. The LAGAMINE code has mainly been used to model the evolution of the Hesbaye aquifer. (See also W89-11016) (Geiger-PTT)
W89-11028

FINITE ELEMENT MODEL FOR AQUIFER SIMULATION WITH APPLICATION IN GANGES-KOBADAK PROJECT,
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
M. M. Hoque.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 157-169, 6 fig, 9 ref.

Descriptors: *Simulation, *Ganges River, *Model studies, *Groundwater movement, *Finite element method, *Aquifer systems, *Computer models, Irrigation programs, Fortran, Mathematical models, Numerical analysis.

A two-dimensional groundwater flow model for a multiaquifer system has been developed using the finite element method together with the Galerkin principle. The model is designed to simulate a variety of problems--confined/unconfined, homogeneous/heterogeneous, isotropic/anisotropic, leaky/nonleaky, steady/unsteady flow with distributed or/and point recharge or discharge. The model at its present stage uses the isoparametric linear elements and has an option to use two or more Gauss integration points. The program has been written in FORTRAN-77 language and can be run on any mainframe computer. The program also can be run on IBM PC/AT microcomputer or compatible system having at least 2 megabytes random access memory. The performance of the model has been tested against analytical and numerical solutions. The model has been found capable of simulating various types of problems very accurately. The model has been applied in the Ganges-Kobadak irrigation project using the available hydrological data. The predicted and observed results are found in close agreement which supports that the average annual recharge of 0.02 m is a reasonable recharge estimate of the area. (See also W89-11016) (Author's abstract)
W89-11029

NUMERICAL SIMULATION FOR SALT TRANSPORT IN COASTAL AQUIFERS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
M. M. Sherif, V. P. Singh, and A. M. Amer.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 171-182, 5 fig, 11 ref.

Descriptors: *Simulation, *Solute transport, *Model studies, *Saline water intrusion, *Coastal aquifers, *Finite element method, India, Groundwater movement, Path of pollutants, Mathematical models, Computer models, Boundary conditions, Leaky aquifers, Confined aquifers, Numerical analysis.

The problem of salt transport in confined and leaky coastal aquifers is simulated under steady state conditions. The Galerkin finite element technique is employed with the computational scheme based on local linearization of nonlinear terms and uses the relaxation method. The model accounts for the dispersion zone in which flow of water and transport of salt ions are coupled. The model is applied to the Madras aquifer in southern India. Cyclic flow is found near the shore boundary. Convergence is attained under different flow and boundary conditions. (See also W89-11016) (Author's abstract)
W89-11030

COMPUTER APPLICATION TO GEOELECTRIC EXPLORATION FOR GROUND WATER IN DESERT AREAS,
Zagazig Univ. (Egypt). Dept. of Geology.
A. Samir.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 183-195, 5 fig, 29 ref.

Descriptors: *Electrical studies, *Model studies, *Sounding, *Computers, *Geohydrology, *Groundwater potential, *Remote sensing, *Deserts, Arid lands, Mathematical studies, Subsurface mapping, Soil water, Interstitial water, Electrodes, Graphical methods, Sounding.

In hydrogeological studies, the geoelectric method can furnish some valuable information on subsurface layers. However, undisturbed sounding graphs are seldom obtained from field measurements particularly in arid regions. Smoothing of the noisy-data is based on the transformation of the Schlumberger field curve to the corresponding pole-pole curve as an intermediate step. Subsequent retransformation to the Schlumberger system allows noise-free and smooth curves adequate for quantitative analysis. An iterative non-automatic interpretation procedure based on the linear filter theory is used where the effect of equivalence can be sufficiently observed for a particular geological setting. Use of the procedure is illustrated in the Sinai peninsula and the Sinai coastal area. (See also W89-11016) (Author's abstract)
W89-11031

2G. Water In Soils

DYNAMICS OF PARTIAL ANAEROBIOSIS, DENITRIFICATION, AND WATER IN A SOIL AGGREGATE: SIMULATION,
Agricultural Univ., Wageningen (Netherlands). Dept. of Theoretical Production Ecology.
P. A. Leffelaar.
Soil Science SOSCAK, Vol. 146, No. 6, p 427-444, December 1988. 7 fig, 27 ref.

Descriptors: *Soil chemistry, *Water chemistry, *Anaerobic conditions, *Soil aggregates, *Simulation analysis, *Soil water, Hysteresis, *Denitrification, Bacteria, Oxygen, Carbon dioxide, Nitrous oxide, Nitrogen, Neon, Glucose, Atmospheric pressure, Model studies, Soil porosity, Sensitivity analysis.

A simulation model was developed to study the dynamics of partial anaerobiosis and denitrification in unsaturated soil. The model enables one to calculate simultaneously the distribution of water, bacteria, oxygen, carbon dioxide, nitrous oxide,

molecular nitrogen, neon, absolute soil atmospheric pressure, nitrate, nitrite, and glucose as a function of space and time in an unsaturated, homogeneous, cylindrical aggregate, and the changes in atmospheric composition as a function of time in the chamber that contains the aggregate. The simulated results showed a satisfactory agreement with experimental data. Hysteresis in the soil water retention curve resulted in low values of the gas-filled porosities in the outer shell of the partially wetted aggregate, permitting only gaseous exchange through the water phase of soil. As a result anaerobiosis and denitrification occurred. It was concluded that appropriate model parameterization was needed first. Therefore, the model will be used to plan respirometer experiments to help interpret the experimental data obtained, and to investigate the relative importance of a number of parameters in a sensitivity analysis. (Author's abstract)
W89-10646

INFLUENCE OF CHANGES IN METHANOL CONCENTRATION ON CLAY PARTICLE INTERACTIONS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W89-10746

GRANULAR SOILS IN RIGID-WALL PERMEAMETERS: METHOD OF DETERMINING THE DEGREE OF SATURATION,
Ecole Polytechnique, Montreal (Quebec).
R. P. Chapuis, K. Baass, and L. Davenne.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 71-79, February 1989. 10 fig, 46 ref. Natural Sciences and Research Council of Canada grant U-0502.

Descriptors: *Soil properties, *Hydraulic conductivity, *Permeameters, Design criteria, Laboratory equipment, Standards, Saturation.

The standard test method was used to determine the hydraulic conductivity of a clean granular soil (rigid-wall permeameter-constant head difference) requires that the specimen be saturated using an air-vacuum pump. However, no method is provided to verify whether the sample is fully (100%) saturated. Such a method is proposed here and its accuracy has been established. The method allows for quality control of the rigid-wall permeameter itself: it can detect if it is watertight but not airtight, according to the achieved degree of saturation. A detailed example is given on a proposed data sheet. The reasons for partial saturation and the problems related to air bubbles were examined. The result is a simplified test to check a permeameter, based on the fact that, for unsaturated conditions, the hydraulic conductivity depends on which of two ways the water seeps in a given direction. A few modifications in the preparation of the specimen and the test procedure are suggested so as to improve the quality of test results. These include: soaking the specimen, filling the piezometer tubes to a level very close to that of the outlet to avoid excessive lateral gradients, verification of airtightness of all permeameter parts and joints, and the use of de-aired water for the initial saturation and during the test. (Rochester-PTT)
W89-10748

HEXAZINONE RESIDUES AND DISSIPATION IN SOIL LEACHATES,
Northern Forest Research Centre, Edmonton (Alberta).
For primary bibliographic entry see Field 5B.
W89-10766

STIGOBIOLOGICAL CHARACTERISTICS OF THE ALLUVIAL AND PLIOCENE WATERS IN THE DISTRICT OF JAMBOL (STIGOBIOLOGICHNA KHARAKTERISTICKA NA ALUVIALIN I PLIOTSENSKI VODI V YAMBOLSVI OKR'G),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-10857

RESIDUAL EXPLOSIVES CRITERIA FOR TREATMENT OF AREA P SOIL, LOUISIANA ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5G.
W89-10997

PARAMETER IDENTIFICATION IN UNSATURATED FLOW AND SOLUTE TRANSPORT MODELS,
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
R. Abeliuk.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 131-142, 6 fig, 3 tab, 19 ref.

Descriptors: *Solute transport, *Unsaturated flow, *Soil water, *Groundwater movement, *Model studies, *Parameterization, Path of pollutants, Mathematical models, Numerical analysis, Infiltration, Porous media, Soil water, Hydraulic properties, Computer models, Optimization, Soil moisture retention, Calibrations, Soil properties, Estimating.

The use of an optimization technique to evaluate model parameters from measured profiles of moisture content and solute concentration is reported. In addition a further application of a parameter identification technique to estimate the parameters governing Richards' equation is described. The main differences between this and previous work reside in the choice of calibration data and the estimation of the parameters governing the equation for unsaturated flow conditions. Rosenbrock's procedure was applied in a series of trials to the determination of the parameters of the hydrodynamic dispersion coefficient. The values corresponding to Gaudet's experimental data are also given for purposes of comparison. It was observed that the values found by the optimization method are independent of the parameters governing the flow equation. To test this point, three optimization runs were carried out using Gaudet's parameters for the flow data and the guesses for W and n (the parameters to be estimated by optimization). The minor discrepancies observed in the flow field parameters can be attributed to minor differences in the calculations of flow velocities and moisture contents with the different parameter sets for the flow equation. The results show that the technique used is capable of identifying the parameters governing both the water flow and the solute transport equations. More than one set of parameter values fit the experimental data; this may be attributed to strong parameter interaction. Parameter non-uniqueness is only relevant when the purpose of using a search technique is to solely identify the parameters governing the hydraulic and dispersive properties of the soil. When the objective is to estimate a set of parameters to predict flow and solute behavior, parameter non-uniqueness ceases to be a problem. (See also W89-11016) (Geiger-PTT)
W89-11027

SIGNAL PROCESSING IN ACOUSTIC EMISSION BEHAVIOR IN SOILS,
Lublin Technical Univ. (Poland).
W. Golygowski, and J. Skrynicki.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 197-203, 5 fig, 2 ref.

Descriptors: *Model studies, *Acoustics, *Soil analysis, *Remote sensing, *Spectral analysis, *Soil water, Seepage, Groundwater movement, Mathematical models, Soil properties, Geophysics, Percolation, Quantitative analysis.

Recent research has confirmed the phenomenon of acoustic emission in agricultural soils. All the methods of acoustic emission signals analysis (i.e. number of events, average value of amplitude, and spectral analysis) are applicable). During water seepage in soils acoustic emission is observed, even during natural percolation. Acoustic emission spectral analysis shows that different spectrograms may be obtained at various stages of deformation of soil samples. Spectrograms of acoustic emissions obtained by the classical FFT method are hard to utilize. The linear prediction technique brings smooth spectrograms on the basis of which more detailed inferences can be drawn, including those of quantitative character. The greater the number of poles used, the greater the spectral density of the signal. However, for more poles, more computation is needed, so that an optimum number of poles must be established. Good results are achieved by using the 8 pole model for the linear prediction analysis of acoustic emission signals in soils. (See also W89-11016) (Author's abstract)
W89-11032

2H. Lakes

BACTERIVORY BY BENTHIC CILIATES: SIGNIFICANCE AS A CARBON SOURCE AND IMPACT ON SEDIMENT BACTERIA,
Brookhaven National Lab., Upton, NY.
P. F. Kemp.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 163-169, November 10, 1988. 3 fig, 1 tab, 28 ref.

Descriptors: *Cycling nutrients, *Food chains, *Sediments, *Benthos, *Protozoa, *Carbon, *Bacteria, *Fluorescence, *Bacterivores, Sediments, Bacterial analysis, Predation, Fluorescently labeled bacteria.

Recently introduced techniques allow quantitative evaluation of the importance of benthic protozoa as bacterivores. Short-term protozoan grazing can be measured using monodispersed fluorescent latex microspheres or more recently monodispersed, fluorescently-labelled bacteria (FLB). Ciliate grazing measured by the FLB method was compared to bacterial production measured by the incorporation of tritiated thymidine into DNA. Protozoan bacterivory is generally recognized as an important process influencing bacterial abundance in pelagic ecosystems, and as a possible pathway for transfer of bacterial production to metazoans. The role of ciliated protozoa as bacterivores in shallow-water benthic systems was examined. Bacterivory would support reasonable growth rates for smaller ciliates in saltmarsh and saline pond sediments, whereas ingestion rates of larger ciliates were too low to support reasonable growth rates. Predicted ciliate bacterivory in saltmarsh, saline pond and mangrove sediments would account for less than 4% of bacterial abundance per day or of minimum hourly bacterial production. In order for ciliate bacterivory to control bacterial abundance in sediment, ciliates must be very much more abundant or ingest bacteria at very much higher rates than measured in this study. These results suggest that benthic ciliated protozoa are minor vectors for direct transfer of bacterial production to metazoan food webs. (Author's abstract)
W89-10542

IS THE LOWER HUDSON-RARITAN ESTUARY A SUITABLE HABITAT FOR GONYAULAX TAMARENSIS,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
For primary bibliographic entry see Field 2L.
W89-10543

MICROBIAL COLONIZATION ON NATURAL AND ARTIFICIAL MACROPHYTES IN A PHOSPHOROUS-LIMITED, HARDWATER LAKE,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
J. M. Burkholder, and R. G. Wetzel.
Journal of Phycology JPYLAJ, Vol. 25, No. 1, p 55-65, March 1989. 5 fig, 4 tab, 47 ref.

Descriptors: *Microbiological studies, *Limnology, *Lakes, *Macrophytes, *Epiphytes, *Phosphorus, *Limiting nutrients, Nutrients, Leaves, Hard water, Species composition.

Epiphyte communities in a phosphorous-limited hardwater lake (Lawrence Lake, Michigan) were compared over a 14-week period from Potamogeton illinoensis and structurally similar artificial plants of different leaf ages. Artificial plants were serially incubated in the lake to simulate the age of natural leaves. The physiognomy of loosely attached epiphytes appeared similar on the two substrata. Algal cell number and biovolume were 15-fold and 17-fold higher, respectively, on artificial leaves early in the growing season, but total algal density gradually became similar on natural and artificial plants. In contrast, the taxonomic composition of loosely attached algae became increasingly distinct, and mean cell biovolume on natural leaves was twice that on artificial leaves. Adnate epiphytes on both substrata developed from sparse populations of bacteria on new leaves to a community of diatoms, blue-green algae and numerous bacteria on mature and senescent leaves. Adnate community succession on natural leaves in late senescence/death differed from that on artificial leaves colonized for comparable periods in having: (1) a marked increase in filamentous blue-green algae, (2) a subsequent decrease in all algae, and (3) a final fungi-dominated state. The trends in colonization indicate that macrophytes in this oligotrophic lake provided a distinct habitat from that of artificial substrata for epiphytes throughout the growing season. (Author's abstract)
W89-10570

EVIDENCE OF DARK AVOIDANCE BY PHOTOTROPHIC PERIPHYTIC DIATOMS IN LOTIC SYSTEMS,
National Hydrology Research Inst., Saskatoon (Saskatchewan). Aquatic Ecology Div.
M. L. Bothwell, K. E. Suzuki, M. K. Bolin, and F. J. Hardy.
Journal of Phycology JPYLAJ, Vol. 25, No. 1, p 85-94, March 1989. 5 fig, 7 tab, 27 ref.

Descriptors: *Epiphytes, *Stream biota, *Limnology, *Rivers, *Diatoms, *Light penetration, *Phototropism, *Lotic environment, Phototrophism, Colonization, Buoyancy, Succession.

Short-term (24-48 hours) colonization dynamics of periphytic diatoms on artificial (styrofoam) substrata were examined using fast-flushing, continuous-flow troughs located on the North Thompson River (British Columbia). Two parallel troughs, one exposed to natural light and the other completely darkened, showed significant differences in periphyton biomass, chlorophyll a, and algal taxonomic composition with 24 hours. Experiments which commenced at the onset of natural darkness demonstrated that rates of algal immigration during the night were the same in both troughs. With 2-3 hours of sunrise, however, certain diatom species (most notably Hannaea arcus Patr. and Diatoma tenue Ag.) selectively emigrated from the artificially darkened trough but remained in the trough exposed to natural light. More closely adhering species, such as Achnanthes minutissima Kutz., also showed significant emigration from the darkened trough after light deprivation for two photoperiods. Data from adhesion, emigration, and sinking rate experiments indicate that differential egress of cells from the darkened versus the lighted environments is the result of cellular regulation of buoyancy or form resistance. (Author's abstract)
W89-10571

EFFECT OF CONCENTRATION BOUNDARY LAYER ON CARBON LIMITED ALGAL BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. K. Liehr, M. T. Suidan, and J. W. Eheart.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 320-335, April 1989. 10 fig, 1 tab, 15 ref.

Descriptors: *Stream biota, *Model studies, *Biodegradation, *Limnology, *Wastewater treatment, *Biofilms, *Algal growth, *Limiting factors, *Carbon, *Boundary layers, Mathematical models, Carbon dioxide, Biochemistry, Fluctuations, Films, Thickness, Mass transfer, Substrates, Hydrogen ion concentration, Biodegradation, Biological wastewater treatment, Experimental design.

Models such as these are useful in predicting the effect of the concentration boundary layer in natural biofilms and thus on the oxygen, carbon, and nutrient balance in streams; in designing engineered systems for wastewater treatment; and in designing laboratory experiments to study such systems. A model was developed to describe mass transport resistance through a concentration boundary layer associated with an algal biofilm. This model is solved simultaneously with a model for attached algal growth subject to inorganic carbon limitation. The profile of inorganic carbon species through the boundary layer was found to be nonlinear due to the interaction of inorganic carbon speciation and pH. As CO2 is utilized by the algae, the pH in the biofilm increases, causing a pH gradient across the boundary layer. This pH increase across the boundary layer causes a corresponding shift of inorganic carbon species away from CO2, which is the form utilized by the algae. As a result of this nonlinear interaction with pH, there is an especially significant decrease in the flux of inorganic carbon into the biofilm, and thus in biofilm growth, as the boundary layer increases in thickness. There results show that models that assume constant pH will overpredict the flux of inorganic carbon. Biofilm thickness is important in determining the impact of the boundary layer. Very thin biofilms that are fully penetrated with CO2 are not sensitive to boundary layer thickness. As the biofilm thickness increases, sensitivity to the boundary layer thickness increases, until the flux reaches the maximum possible (J sub max) and becomes independent of biofilm thickness. The magnitude of the effect is dependent on a complex interaction of bulk pH, bulk inorganic carbon concentration, and alkalinity. (Author's abstract)
W89-10576

UNDERWATER DAM AND EMBAYMENT AERATION FOR STRIPED BASS REFUGE,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 8I.
W89-10582

ISOLATION OF THREE WATER MOLDS FROM TWO FRESHWATER FISHES AND INSECT EXUVIAE,
Scientific Research Council, Baghdad (Iraq).
A. K. N. Butty, F. T. Mhaisen, and N. M. Ali.
Journal of Environmental Science and Health (A) JESEDU, Vol. A24, No. 1, p 17-22, January 1989. 11 ref.

Descriptors: *Fish parasites, *Molds, *Insects, *Aquatic fungi, *Pathogenic fungi, *Iraq, *Fish, Carp, Mullet, Insects, Infection, Parasites, Fish diseases.

During March 1988, a power failure forced fish in indoor tanks at the Department of Hydrobiology of the Biological Research Center at Al-Rashidiya (Iraq), to be moved to outdoor tanks which were filled with water from the Tigris river. This water was not changed for several weeks. A few dead and live fingerlings of the common carp (Cyprinus carpio), and mullet (Liza abu), and fallen honey bees (Apis mellifera) and California flies (Calliphora sp.) were examined for any fungal growth. Two L. abu, six C. carpio, 25 A. mellifera and two Calliphora sp. were infected with the following fungi: Saprolegnia ferax S. terrestris and Achyla polyandra. Occurrence of the fungi represents their first record in C. carpio and L. abu in Iraq. As few fishes in the present study were infected, it may be concluded that these fungi are opportunistic facultative parasites. (Author's abstract)
W89-10587

STUDY OF NITRATE AND NITRITE IN THALE SAP SONGKLA: WATER QUALITY OF THALE SAP SONGKLA I,
Prince of Songkla Univ. (Thailand). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-10591

FISH FAUNA OF CURUA-UNA RESERVOIR, SANTAREM, PARA: II. FOOD AND FEEDING HABITS OF THE MAIN SPECIES (A ICTIOFAUNA DA REPRESA HIDRELETRICA DE CURUA-UNA, SANTAREM, PARA.: II. ALIMENTACAO E HABITOS ALIMENTARES DAS PRINCIPAIS ESPECIES),
E. J. G. Ferreira.
Amazoniana, Vol. 9, No. 1, p 1-16, December 1984. 2 fig, 3 tab, 16 ref. English summary.

Descriptors: *Reservoirs, *Fish behavior, *Food habits, *Amazon, Species composition, Curua-Una reservoir, Dams, Tropical regions, Brazil.

This paper reports on a study of the food and feeding habits of the principal fish species of the Curua-Una hydroelectric reservoir in the Amazon basin. One thousand four hundred sixty-three stomachs from the 29 most frequent fish species of 50 species caught were analyzed. The species were classified according to the food consumed in one of the following groups: detritivores, herbivores, carnivores and piscivores, eating mainly detritus, vegetal matter (algae), invertebrates (crustaceans and insects) and fish. The grouped results for the stations above the dam show that herbivores are dominant with 42.2% of the biomass, followed by carnivores (30.7%), piscivores (25.5%) and detritivores (1.4%). It was not possible to establish a standard for comparison with other tropical reservoirs on the basis of the trophic structure of the fish community. It is suggested that the trophic structure is possibly related to the composition of the ichthyofauna before damming and the biological adaptiveness of each species to the new conditions. (Author's abstract)
W89-10592

ABOUT THE RELATIONSHIP BETWEEN THE ZOOPLANKTON AND FLUCTUATING WATER LEVELS OF LAGO CAMALEAO, A CENTRAL AMAZONIAN VARZEA LAKE,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
E. R. Hardy, B. Robertson, and W. Koste.
Amazoniana, Vol. 9, No. 1, p 43-52, December 1984. 4 fig, 2 tab, 11 ref.

Descriptors: *Lakes, *Zooplankton, *Crustaceans, *Water level fluctuations, *Brazil, *Flooding, *Amazon River, Species composition, Population density, Rotifers, Copepods, Waterfleas, Lago Camaleao, Tropical regions.

Throughout 1981 and 1982 a study of the composition and abundance of the three main groups of zooplankton, Rotifera, Copepoda, and Cladocera, was conducted in Lago Camaleao, an Amazonian floodplain lake. Rotifers are dominant both in terms of species numbers and abundance. Rotifers exhibit two standing-stock peaks during the year: one during the extreme dry season and another at the beginning of the rising water period. The species associations of rotifers also reflect the flooding regimes and its consequences. The extremely low standing-stock observed during the high water season is attributed mainly to prevailing poor oxygen conditions during normal floods and current during extreme floods. (Author's abstract)
W89-10594

ORIGIN AND MORPHOLOGY OF THE COASTAL LAGOONS OF RIO GRANDE DO SUL, BRAZIL (GENESE E MORFOLOGIA DAS LAGOAS COSTEIRAS DO RIO GRANDE DO SUL, BRASIL),
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
A. Schwartzbold, and A. Schafer.
Amazoniana, Vol. 9, No. 1, p 87-104, December 1984. 4 fig, 3 tab, 44 ref. English summary.

Descriptors: *Coastal lakes, *Brazil, *Saline lakes, *Lagoons, *Lake morphology, Rio Grande do Sul, Tropical regions, Water depth, Mathematical equations.

The ecological and biogeographical classification of the coastal lakes from the Rio Grande do Sul are discussed. The coastal lakes can be classified based on their morphological structure, in relation

to their nutrient contents and their communities. The three groups are: 1. deep lakes up to 11 m; 2. medium-deep lakes up to 3.5 m; and 3. shallow lakes with a maximum depth of 1.5 m. Based on these investigations, a new formula for calculating the medium depth is proposed. The relation between the maximum and medium depth is z=0.75z sub max to the 0.83 power, which can be considered as typical for the morphological characteristics of extreme shallow lakes or lagoons. (Author's abstract)
W89-10595

INVESTIGATIONS ON THE SEASONAL CHANGES IN THE CHEMICAL COMPOSITION OF LIVER AND CONDITION FROM A NEOTROPICAL CHARACOID FISH COLOSSOMA MACROPOMUM (SERRASALMIDAE),
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
U. Saint-Paul.
Amazoniana, Vol. 9, No. 1, p 147-158, December 1984. 6 fig, 1 tab, 27 ref.

Descriptors: *Fish physiology, *Fish diets, *Amazon River, *Flood plains, Water level fluctuations, Metabolism, Liver, Fat, Proteins, Carbohydrates, Seasonal variation, Tropical regions, Brazil, Fish food, Flood plain vegetation, Glycogen.

Annual fluctuations in the water level of the Amazon River system change the living conditions of juvenile Colossoma macropomum. Due to a greatly reduced food supply during the low-water periods, the fish must metabolize their reserve material to meet the energy needs, as demonstrated by a reduction of both the glycogen-somatic index and the protein content of the filet. No changes in the visceral fat content were detected. With rising water level the grain of Oryza perennis (Gramineae) becomes available as food and consequently an increase in the glycogen content of the liver was detected. A delay and a reduction in the production of O. perennis prevents the improvement in the conditions of the starved fish. A change in the seasonal water fluctuation, caused by deforestations, would destroy the food sources for fruit and seed eating fish species. (Author's abstract)
W89-10596

TEMPORARY FAT STORAGE, AN ADAPTATION OF SOME FISH SPECIES TO THE WATER LEVEL FLUCTUATIONS AND RELATED ENVIRONMENTAL CHANGES OF THE AMAZON RIVER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. J. Junk.
Amazoniana, Vol. 9, No. 3, p 315-351, December 1985. 14 fig, 4 tab, 32 ref.

Descriptors: *Fish physiology, *Amazon River, *Flood plains, *Fish diets, Water level fluctuations, Fats, Metabolism, Seasonal variation, Tropical regions, Brazil, Migratory species, Spawning.

Analysis of Amazonian freshwater fish exhibited great differences in water and fat content. Water, fat, protein and ash content was studied in 40 fish species, belonging to 32 genera and 16 families. 10 species were analyzed over one year on a monthly basis, and 4 over 2 years. In all 2548 fish were analyzed. Migratory species which deposit huge amounts of eggs in a single spawning act accumulate at high water level large amounts of fat in various parts of the body. Nonmigratory species which spawn small quantities of eggs several times per year show little or no seasonality in fat storage. Fat storage is related to the energy requirements of the species and is considered a very successful strategy by which many Amazonian fish species survive drastic environmental and related food supply changes, which are a result of the large monomodal water level fluctuations of the Amazon and its tributaries. (Author's abstract)
W89-10597

LIGHT REGIMES IN THREE AQUATIC ECOSYSTEMS OF DIFFERENT PHYSICOCHEMICAL PROPERTIES: I. ATTENUATION, IRRADIANCE REFLECTANCE AND COMPARISON BETWEEN DOWNWELLING, UPWELLING AND SCALAR IRRADIANCES (PAR) (LICHTKLIMADATEN IN DREI AQUATISCHEN OKOSYSTEMEN VERSCHIEDENER PHYSIKALISCH-CHEMISCHER BESCHAFFENHEIT: I. ABSCHWACHUNG, RUCKSTREUUNG UND VERGLEICH ZWISCHEN EINSTRAHLUNG, RUCKSTRAHLUNG UND SPHARISCH GEMESSENER QUANTENSTROMDICHTE (PAR)),
Kiel Univ. (Germany, F.R.). Botanisches Inst.
B. Furch, A. F. F. Correa, J. A. S. N. De Mello, and K.-R. Otto.
Amazoniana, Vol. 9, No. 3, p 411-430, December 1985. 10 fig, 18 ref. English summary.

Descriptors: *Limnology, *Lakes, *Amazon River, *Light penetration, *Solar radiation, Tropical regions, Turbidity, Humic acids, Flood plains.

In two tropical lakes, one on the white water floodplain with a concentration of suspended solids (tripton) of 100 mg/l, and one on the black water floodplain stained by humic substances (gilvin) of 130-170 HAZEN, situated in Central Amazonia, measurements of the light regime were made. Two types of collectors were used to measure the hemispherical (cosine) and the spherical (scalar) incident solar radiation in the PAR wave band (photosynthetically active radiation). From these data the coefficients for the irradiance reflectance, extinction for downward irradiance, and the depth of the euphotic zone were calculated for the so-called Varza (white water) and Igapo (black water) lakes and all values were compared to those obtained in the water body of an oligotrophic lake in Northern Germany. Compared with these unstable as well as most unusual light regimes the Schohsee with its clear, uncolored water exhibits the common known characteristics already reported for oligotrophic lakes concerning the downwelling and upwelling quantum fluxes (straight lines, nearly parallel to each other), reflectance and transmission. For all three lakes the values for downward plus upward irradiances are compared with those of the spherical quantum flux densities. The consequences of the very extreme light regimes for the biota in the two tropical lakes are discussed. (Author's abstract)
W89-10599

STUDIES ON TWO MIGRATORY FISH FROM LOWER TOCANTINS RIVER BEFORE CLOSURE OF TUCURUI DAM (ESTUDOS SOBRE DOIX PEIXES MIGRATORIOS DO BAIXO TOCANTINS ANTES DO FECHAMENTO DA BARRAGEM DE TUCURUI),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
For primary bibliographic entry see Field 8I.
W89-10600

EXPERIMENTS ON COLONIZATION OF SMALL WATER BODIES BY CULICIDAE AND CHIRONOMIDAE AS A FUNCTION OF DECOMPOSING PLANT SUBSTRATES AND THEIR IMPLICATIONS FOR NATURAL AMAZONIAN ECOSYSTEMS,
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
I. Walker.
Amazoniana, Vol. 10, No. 1, p 113-125, December 1986. 3 fig, 2 tab, 18 ref.

Descriptors: *Aquatic insects, *Food chains, *Decomposing organic matter, *Limnology, *Amazon River, Grasses, Aquatic bacteria, Fungi, Trees, Litter, Hydrogen ion concentration, Conductivity, Larvae, Mosquitoes.

The effect of submersed decomposing organic matter on the colonization of small water bodies by insects (notably Culicidae and Chironomidae) was analyzed. It was found that grass (Echinochloa polystachea) is decomposed by bacteria, and that oviposition by Culicidae is correlated with bacterial density. In containers with submerged forest litter (decomposing prevalently by fungi) bacterial densities remain roughly as low as in water controls, and oviposition by Culicidae is sporadic. Green leaves of forest trees show an inconsistent pattern except for the correlation between bacterial density and colonization by Culicidae. Chironomidae are little affected by the substrate in decomposition during the one month of the test series. Initial water quality (black, rain, pH, conductivity) has little or no effect on decomposition and colonization processes, and development of the aquatic insects is normal under all regimes provided there is food for the larvae. Water quality, however, is the result of the decomposition process: specific pH values are stabilized by the plant substrates. Decomposition of forest litter by fungi inhibits growth of bacteria. The results are suggestive of possible interrelations between chemical, biological and ecological factors in natural Amazonian waters. (Author's abstract)
W89-10601

CAMPSURUS NOTATUS (POLYMITARCIDAE, EPHEMEROPTERA), A BIOTURBATOR IN VARZEA LAKES,
Max-Planck-Inst. fuer Limnologie, Schlitz (Germany, F.R.). Limnologische Flussstation.
U. Nolte.
Amazoniana, Vol. 10, No. 1, p 219-222, December 1986. 15 ref.

Descriptors: *Limnology, *Bioturbation, Lakes, *Aquatic insects, *Mayflies, Campsurus, Tropical regions, Brazil, Larval growth stage, Bioturbation, Sediment-water interfaces, Varzea lakes, Larvae.

The Neotropical mayfly Campsurus notatus occurs abundantly in varzea lakes, requiring about three months for its aquatic development. Contrary to other suggestions its aquatic instars are shown to be sediment feeders. The nymphs burrow continuously in the loose sediment without building stable tubes. This organism is therefore an important agent for bioturbation and consequently for chemical exchange at the sediment/water interface. (Author's abstract)
W89-10602

ECOLOGICAL ASPECTS OF THE FISH FAUNA OF THE MUCAJAI RIVER, IN THE PAREDAO ISLAND REGION, RORAIMA, BRAZIL (ASPECTOS ECOLOGICOS DA ICTIOFAUNA DO RIO MUCAJAI, NA AREA DA ILHA PAREDAO, RORAIMA, BRASIL),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
E. Ferreira, G. M. Santos, and M. Jegu.
Amazoniana, Vol. 10, No. 3, p 339-352, October 1988. 2 fig, 5 tab, 17 ref. English summary.

Descriptors: *Brazil, *Rivers, *Fish populations, Species composition, Dams, Mucajai River, Species diversity.

An ichthyofauna survey was carried out in the Paredao Island region of the Mucajai River, where a hydroelectric dam may be built in the future. A total of 126 fish species, belonging to 28 families, were caught at two collecting sites, one below and the other above the Paredao 2 falls. Although these two stations were separated by a 20 m waterfall, the similarity between the two communities was high. Shannon's diversity index, evenness and catch per unit effort were rather high compared to other Amazonian rivers. The high value of equitability (0.82) suggests that the fish communities are in equilibrium. In terms of biomass, the predator species were dominant; in number of specimens the detritivores were more abundant. It is expected that construction of a dam would effect the equilibrium of the fish communities in this area by lowering the number of fish species and changing the composition of the fish communities. (Author's abstract)
W89-10603

WATER LEAKAGE FROM LAKE CHUZENJI, NIKKO,
Utsunomiya Univ. (Japan). Faculty of Education.
M. Hirayama, K. Murakami, and J. Koyama.
Japanese Journal of Limnology RIZAAU, Vol. 49,

No. 4, p 251-260, October 1988. 7 fig, 2 tab, 16 ref.

Descriptors: *Lakes, *Surface-groundwater relations, *Springs, Discharge rates, Catchment areas, Water temperature, Lake Chuzenji, Japan, Leakage, Seepage springs.

From examinations of water quality and water temperature springs adjacent to the east coast of Lake Chuzenji were classified into the following two types: (1) a lake type in which the water quality has a close resemblance to the lake; and (2) non-lake type in which the water quality is quite different from the lake. The lake type spring has a lower temperature in the summer and a smaller annual temperature range than those of the non-lake type. The source of the lake type spring is attributed to the lake. The water leaked from the lake discharges at Kegon Springs, Elevator Springs, Shirakumo Springs and Houdou Springs. Agon Springs and Han'hya Springs have a water source other than the lake. The lake water appears to leak at a depth of about 30 m or more below the lake surface, i.e., at the lower metalimnion in summer. Calculations of the water balance of the catchment area gave an estimated discharge rate of leakage of 5.13 cu m/s against the measured spring discharge of 5.07 cu m/s. The water leakage reached 69.7% of the total discharge from the lake. (Author's abstract)
W89-10605

NET INCREASE RATES AND DYNAMICS OF PHYTOPLANKTON POPULATIONS UNDER HYPEREUTROPHIC AND EUTROPHIC CONDITIONS,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
Y. Ogawa.
Japanese Journal of Limnology RIZAAU, Vol. 49, No. 4, p 261-268, October 1988. 4 fig, 2 tab, 13 ref.

Descriptors: *Limnology, *Phytoplankton, *Population dynamics, *Eutrophic lakes, *Nutrients, Nitrogen, Phosphorus, Seasonal variation, Microcystis, Cyclotella, Scenedesmus, Mathematical models, Himonya Pond, Lake Nakanuma, Japan.

The relationships between net increase rates of phytoplankton populations and ambient concentrations of nutrients were investigated in hypereutrophic Himonya Pond and eutrophic Lake Nakanuma, and were expressed by a hyperbolic function for Microcystis aeruginosa, Cyclotella kutzingiana and Scenedesmus quadricauda. M. aeruginosa increased faster than the other species in low concentrations of total inorganic N, whereas C. kutzingiana and S. quadricauda increased faster than M. aeruginosa in low concentrations of phosphate-P. Using a mathematical model based on these relationships, the population dynamics of the planktonic algae were analyzed in hypereutrophic conditions and slightly eutrophic conditions. In hypereutrophic conditions, a large amount of phosphate-P caused M. aeruginosa to develop into a large population, and then caused the phytoplankton diversity to drop to a low level. On the other hand, in slightly eutrophic conditions, phytoplankton did not develop into large populations, and thus the phytoplankton diversity remained at a high level. This was because low nutrient concentrations limited the population increase of each species. The results of the model analysis coincided with the patterns observed in the field surveys, and showed that the amount of nutrients available for phytoplankton played an important role in the regulation of phytoplankton dynamics. (Author's abstract)
W89-10606

LONG-TERM CHANGES IN THE LAKE MYVATN ECOSYSTEM,
Iceland Univ., Reykjavik. Biological Inst.
A. Gardarsson, G. M. Gislason, and A. Einarsson.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 125-135, 1988. 7 fig, 1 tab, 57 ref.

Descriptors: *Limnology, *Iceland, *Eutrophication, *Water pollution effects, *Paleolimnology, *Urbanization, Eutrophic lakes, Algae, Crustaceans, Population dynamics, Primary productivity, Monitoring, Ducks, Fish, Aquatic insects, Lake Myvatn, Midges.

In shallow eutrophic Lake Myvatn, Iceland, variation in the abundance of algae, crustaceans and chironomids over the last 2,300 years in sediment cores was investigated. The cores show that densities of the benthic alga Cladophora aegagropila and associated invertebrates (Psectrocladius barbimanus and Eurycercus lamellatus) increased with decreasing depth of the water. The benthic Tanytarsus gracilentus and the planktonic Daphnia longispina showed a downward trend. On a shorter time scale, population changes, as documented by harvest records (ducks, fish) and monitoring studies (ducks, aquatic insects), are considerable and are often associated with food resources. High population levels of profundal chironomids and low population levels of littoral chironomids and the riverine Simulium vittatum coincided with low primary production in the plankton. High population levels of littoral midges and S. vittatum and low population levels of profundal chironomids were associated with high primary production in the plankton. Long-term fluctuations make it difficult to identify the impact of increasing human activity at the lake. (Author's abstract)
W89-10609

NUTRIENTS AND PLANKTIVOROUS FISH AS REGULATORS OF PRODUCTIVITY IN LAKE PYHAJARVI, SW FINLAND,
Turku Univ. (Finland). Dept. of Biology.
J. Sarvala, and K. Jumppanen.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 137-155, 1988. 8 fig, 6 tab, 115 ref. Academy of Finland research contract 09/109 and research grant 09/074.

Descriptors: *Limnology, *Lakes, Primary productivity, *Food chains, *Fish, *Nutrients, Phosphorus, Nitrogen, Phytoplankton, Zooplankton, Chlorophyll a, Diatoms, Lake Pyhajarvi, Finland.

The relative role of nutrients and predators (bottom-up vs. top-down effects) in the regulation of aquatic ecosystems was examined for 8 years' data from Lake Pyhajarvi, SW Finland. This lake is known for its exceptionally high yield of fish relative to primary production. Therefore, the impacts of predators should be easier to detect than in large lakes in general. The dominant commercial planktivore, vendace, shows a regular, although weak, abundance cycle, which can be regarded as a natural experiment with the pelagic system. The P concentration in lake water showed no simple association with the annual input of P, but was negatively correlated with the annual vendace catch. The N concentration was correlated with the total N load of the previous year. Variations in the measured phytoplankton primary production and chlorophyll a closely followed variations in the average P concentration of water and showed a weak positive correlation with the N level. The diatom biomass was strongly correlated with both primary production and P concentration in water. Primary production, chlorophyll and diatom biomass were also correlated with the strength of the juvenile year-class of vendace as measured by the vendace catch during the following winter or the length of vendace after the first summer; chlorophyll a values were significantly higher in years with a strong year class of juvenile vendace. The possible causal mechanisms behind these correlations probably include: (1) suppression of crustacean zooplankton grazers by the strong vendace year classes; (2) changes in nutrient release by zooplankton due to changing size structure; (3) changes in nutrient sedimentation rate in size and species composition of zooplankton; (4) changes in nutrient accumulation in fish biomass; and (5) changes in nutrient sedimentation in fish feces. (Author's abstract)
W89-10610

RESTORATION BY FOOD-WEB MANIPULATION IN THE HYPERTROPHIC LAKE ZWEMLUST (THE NETHERLANDS): THE FIRST TWO YEARS,
Water Board of Utrecht (Netherlands).
E. Van Donk, and W. Rip.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 165-169, 1988. 6 fig, 2 ref.

Descriptors: *Lake restoration, *Eutrophication, *Food chains, *Phytoplankton, *Zooplankton, Algae, Fish stocking, Pike, Rudd, Nitrogen, Phosphorus, Transparency, Chlorophyll a, Cyanophyta, Rotifers, Waterfleas, Daphnia, Recreational lakes.

In the small hypertrophic Lake Zwemlust (1.5 ha; mean depth 1.5 m) food-web manipulation was carried out to reduce the algal blooms which occur during the summer. In March 1987 the lake was completely drained by pumping in order to facilitate complete fish elimination. The lake, which was refilled by seepage, was restocked with pike fingerlings and adult rudds (Scardinius erythrophthalmus). The offspring of the rudd was expected to serve as food supply for the pike. In April 1988 a new year-class of pike fingerlings was introduced. Seedlings of Chara globularis, roots of Nuphar lutea and stacks of Salix twigs were placed as refuge and spawning grounds for the pike and as shelter for the zooplankton. After food-web manipulation in 1987, the P and N concentrations remained high. In summer 1988, in contrast with P which remained high, nitrate and ammonium declined to very low levels. In spite of the high nutrient concentrations in 1987, the effects in that year on the light climate and the phytoplankton and zooplankton community had appeared promising: a pronounced increase in transparency, low chlorophyll a, near-absence of cyanobacteria and a shift from rotifers to cladoceran zooplankton. In spring and summer 1987 the grazing pressure, exerted by the crustacean zooplankton. (especially Daphnia spp.), reduced chlorophyll a and algal abundance to very low levels. In 1988, however, some negative effects occurred, including a decline in transparency due to small algal blooms, a shift from cladocerans to rotifer abundance and an increase in biomass of submerged vegetation. Some species which grew through the entire water column interfered with the recreational use of the lake. While a positive effect of the increased macrophyte biomass in summer 1988 was the uptake of N from the water, resulting in N-limitation for the phytoplankton, the lake still appears to be in an unstable stage. A new fish population dominated by predatory fish, which will control the planktivorous fish, has not yet stabilized. (Sand-PTT)
W89-10611

FAUNA STRUCTURE AND WATER QUALITY,
Goeteborg Univ. (Sweden). Dept. of Zoology.
J. Stenson.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 179-184, 1988. 6 fig, 1 tab, 35 ref.

Descriptors: *Limnology, *Predation, *Lakes, *Lake restoration, *Water quality, *Trophic level, Hydrogen ion concentration, Transparency, Chlorophyll a, Roach, Species composition, Zooplankton, Copepods, Crustaceans, Nutrients, Primary productivity, Fish.

This study was undertaken to investigate the possibility of predicting the reactions of factors commonly used as trophic criteria based upon specific manipulations made on the uppermost trophic level. The work was performed in Lake Lilla Stockelidsvatten, Sweden. In November 1973 the fish population dominated by the roach was eliminated by means of rotenone. In April 1979 the lake was restocked with roach. The sequence of changes initiated by this manipulation was assessed in a control program including pelagic fauna and flora, pelagic primary production, chlorophyll a and basic water chemistry including pH and transparency. The introduction of the roach population implied a radical change of the predation pattern in the lake. This was shown to be true, as evidenced by the drop in abundance of pelagic invertebrates. An introduction of fish and an intensification of the predation on zooplankton were expected to result in changes in the species composition of zooplankton. As expected, the zooplankton changed in the predicted direction, from a community dominated by larger calanoid copepods among the crustaceans and raptorial species among the rotifers to a community dominated by small cladocerans and

suspension feeders. The shift in the structure of the pelagic fauna implied improved nutrient conditions for the pelagic producers. The phytoplankton community went through a complete reorganization during the experiment. The large change in the group of primary producers and their production will affect the basic chemical properties of the lake water. As the pH is mainly a function of the carbonic acid system, changes in the CO2 content will influence the equilibrium reactions between the components of the system, thereby changing pH. The lake ecosystem went through a radical biological rearrangement during the experiment. Structural changes gave rise to functional changes which ultimately resulted in changes of basic abiotic properties of the lake water. The experimental lake changes in a eutrophic direction and water quality changes were in agreement with the initial predictions. The similarities with the lake before the initial elimination of the fish population was apparent not only on a general structural and functional level but also on a species level. (Sand-PTT)
W89-10613

FADING RECOVERY: A CONCEPTUAL MODEL FOR LAKE VESIJARVI MANAGEMENT AND RESEARCH,
Lahti Municipal Lab. (Finland).
For primary bibliographic entry see Field 5C.
W89-10614

LONG-TERM CHANGES IN LITTORAL HABITATS AND COMMUNITIES IN LAKE MIKOLAJSKIE (POLAND),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
E. Pieczynska, T. Ozimek, and J. I. Rybak.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 361-378, 1988. 8 fig, 4 tab, 50 ref.

Descriptors: *Aquatic ecosystems, *Lakes, *Eutrophication, *Water pollution effects, Species composition, Submerged plants, Algae, Aquatic animals, Lake Mikolajskie, Poland, Wastewater outfall, Animal populations, Habitats.

Lake Makolajskie has been seriously affected by both the inflow of raw sewage from the town of Mikolajskie and from tourism. Over the last 20 years the amount of sewage entering the littoral zone has increased as well as the area of artificially transformed shore. The area occupied by macrophytes has decreased markedly. The decline of Phragmites australis, changes in species composition, and reductions in biomass and in the depth-range colonized by submerged plants have been observed. Simultaneously the biomass of algae has increased markedly. Animals characteristic of polluted sites have become more abundant. Changes in animal abundances have resulted to a great extent from changes in the availability of natural substrates. Zonation of organisms has been observed for years at sites directly affected by sewage. Quantitatively and qualitatively poor communities are found at sewage discharge points and the richer ones at a greater distance from the discharge point, in the zone fertilized by diluted sewage. (Author's abstract)
W89-10615

SEASONAL AND SPATIAL OVERLAP BETWEEN CLADOCERANS IN HUMIC LAKES,
Oslo Univ. (Norway). Dept. of Biology.
D. O. Hessen, and A. K. Schartau.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 379-405, 1988. 5 fig, 4 tab, 62 ref.

Descriptors: *Limnology, *Humic substances, *Lakes, *Zooplankton, Crustaceans, Waterfleas, Seasonal variation, Vertical distribution, Migration, Reproduction, Algae, Aquatic bacteria, Detritus, Food, Norway, Niches.

Seasonal and vertical distribution, migratory patterns and reproductive effort in coexisting cladocerans were investigated in three humic lakes with different, but low phytoplankton abundances and varying fish predation pressure., Seasonal and vertical habitat or niche overlap varied, but were high within most pairs of species in all localities. Migration was conspicuous in the presence of planktivorous fish, and less so in the fish-free lake. Despite algal densities below incipient limiting level (30-200 microgram C/L) and a low ratio (3-10) of algal to cladoceran biomass, zooplankton distribution and reproductive parameters were not clearly related to algal biomass. Bacterial biomass equalled 10-50% of phytoplankton biomass, while detritus was by far the largest of the particulate compartments. With a possible exception of the early summer algal bloom, additional carbon sources (bacteria, detritus) are important to cladoceran nutrition in these humic lakes. A large share on N-poor and P-poor detritus in the diet would give zooplankton productivity limitation by food quality in terms of elemental composition rather than food quantity. This would permit coexistence even of species with rather high food overlap, but give low production rates for all species in agreement with the observations. (Author's abstract)
W89-10616

EXPERIMENTAL ANALYSIS OF THE ACID SENSITIVITY OF THE COMMON PLANKTONIC ROTIFER KERATELLA COCHLEARIS,
Kent State Univ., OH. Dept. of Biological Sciences.
K. Havens, and J. DeCosta.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 407-416, 1988. 5 fig, 6 tab, 23 ref.

Descriptors: *Acidification, *Acid rain effects, *Lakes, *Acidic water, *Zooplankton, *Rotifers, Hydrogen ion concentration, Keratella, Lake O'Woods, West Virginia, Population dynamics.

An in situ mesocosm experiment was performed at neutral pH Lake O'Woods, West Virginia, to assess the impacts of acidification on the common planktonic rotifer Keratella cochlearis. This rotifer is typically replaced by K. taurocephala during the acidification of North American lakes. Despite a rapid pH reduction in this experiment (from 7.0 to 4.8 in 14 days), the abundance, mean body length and egg ratio of K. cochlearis did not decline in the acid treatment as compared to the untreated control. These results support the hypothesis that K. cochlearis is acid-tolerant, and suggest that its disappearance from acid lakes is the result of biotic interactions within the plankton, rather than the result of toxic effects of altered water chemistry. (Author's abstract)
W89-10617

CHLOROPHYLL CONCENTRATIONS IN RELATION TO ENVIRONMENTAL PARAMETERS IN DIFFERENT SITUATIONS IN SHOAL LAKE (MANITOBA-ONTARIO),
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 417-429, 1988. 3 fig, 2 tab, 49 ref.

Descriptors: *Limnology, *Lakes, *Phytoplankton, *Chlorophyll a, *Seasonal variation, Hydrogen ion concentration, Phosphorus, Nitrogen, Dissolved oxygen, Water temperature, Light, Alkalinity, Dissolved solids, Principal component analysis, Shoal Lake, Canada, Regression analysis, Productivity.

Seasonal and local chlorophyll-a fluctuations were examined at two depth ranges in Shoal Lake, a productive Precambrian Shield system. Water residence time in the study area was short, without permanent summer stratification. Chlorophyll-a fluctuations were significantly correlated with total molybdenum reactive phosphorus (MRP) and total inorganic nitrogen, but the types of relationships were different for the two nutrients. Chlorophyll a was also significantly positively correlated with total alkalinity and temperature, and inversely correlated with oxygen and light. MRP and dissolved organic matter appeared to be more important for near-bottom chlorophyll than for surface chlorophyll. Principal components analysis suggested that 95% of the total variance in chlorophyll a in the study area could be described within a 4-dimensional hyperspace, but two of these dimensions could not be correlated with known environmental parameters. Chlorophyll concentrations in Shoal Lake are the product of many factors whose relative importance varies with situation. (Sand-PTT)
W89-10618

CALCIUM AND MAGNESIUM IN DAL LAKE, A HIGH ALTITUDE MARL LAKE IN KASHMIR HIMALAYAS,
Kashmir Univ., Srinagar (India). Dept. of Botany.
M. Ishaq, and V. Kaul.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 431-439, 1988. 3 fig, 7 tab, 17 ref.

Descriptors: *Mountain lakes, *Lake sediments, *Calcium, *Magnesium, *Water chemistry, *Limnology, *Phosphorus balance, Seasonal variation, Dal Lake, Himalayan Mountains.

Monthly sampling of Ca and Mg in the inflows and outflows of Dal Lake revealed high concentrations of both during the summer. The monthly inputs, outputs and retentions of these alkaline earths were estimated. The lake on an overall basis showed the retention of Ca but not Mg. This was suspected to be related and affected by variable flushing rates of water. Most of the Ca and Mg was present in sediments and only a small fraction in the water and in the macrophytes. Compartmentalization of P in the lake system revealed the sediments to hold a large reserve of P. The calcium-rich sediment obviously acts as a great trap. Though incoming P has increased by approximately 40% during the past decade (1971-1981), there has not been any significant increase in concentration in the lake system. Thus, Ca is possibly the most important element in the Dal Lake system responsible for buffer capacity and resilience which it has shown so far even under the great anthropogenic stress of the past years. High values of export of dissolved Ca(++) from the Dachigam/Telbal subcatchment exceeding values reported previously for the watershed by several orders of magnitude, imply that the soils of the catchment are very rich in alkaline earths, probably the result of the lacustrine nature of the catchment. (Sand-PTT)
W89-10619

MICROBIAL AND ANIMAL PROCESSING OF DETRITUS IN A WOODLAND STREAM,
Lund Univ. (Sweden). Stream and Bethic Ecology Group.
R. C. Petersen, K. W. Cummins, and G. M. Ward.
Ecological Monographs ECMOAG, Vol. 59, No. 1, p 21-39, March 1989. 8 fig, 8 tab, 95 ref. DOE Grant DE-ATO6--79-1004, NSF Grant BMS-74-20716-AO1, DOE Grant DE-FGO5-85EV60301.

Descriptors: *Detritus, *Microbiological studies, *Macroinvertebrates, *Stream biota, *Ecosystems, Decomposing organic matter, Organic loading, Biomass, Riffles, Litter, Standing crops, Particulate matter, Respiration, Assimilative capacity, Animal populations, Feeding rates, Soil-water-plant relationships.

The detritus standing crop, microbial respiration, and macroinvertebrate biomass were examined in monthly samples from the riffle sections of a first-order woodland stream. Total detritus was remarkably constant; the average ash-free dry mass standing crop was 426.4 +or-85.9 g/sq m over the 14 months of the study. Throughout the year benthic detritus was dominated by fine particulate detritus (<1 mm), which made up 68.9% of the total ash-free dry mass. Woody debris made up 8%, whole leaves 3.5%, and leaf fragments and other coarse particulate detritus accounted for 19.7% of the total standing crop. Decreases in standing crop were attributable to microbial respiration, macroinvertebrate assimilation, and downstream export. Microbial respiration annually removed 150% of the average standing crop, with the major effect on the smallest particle size category. Macroinvertebrate assimilation, defined as the sum of respiration and growth, removed 11.6% of the detritus standing crop annually. Shredders accounted for 20% of

total animal assimilation, with the remaining 80% attributable to collectors and grazers. Based on monthly changes, it appears that total detritus standing crop is the result of the past discharge regime, which determines the overall amount of detritus present, and the rate of biological (microbial and invertebrate) processes, which determine the size and quality of the detritus particles. This suggests that detritus in streams, while strongly affected by both biotic and abiotic factors, may be in equilibrium within physical and biological constraints such that an annual steady-state system exists, similar to that for soil systems. (Author's abstract)
W89-10648

EFFECTS OF FLOW REGIME AND CYPRINID PREDATION ON A HEADWATER STREAM,
North Dakota Univ., Grand Forks. Dept. of Biology.
I. J. Schlosser, and K. K. Ebel.
Ecological Monographs ECMOAG, Vol. 69, No. 6, p 41-57, Mar 1989. 12 fig, 7 tab, 76 ref. NSF Grants BSR 8320371 and BSR 8804926.

Descriptors: *Hydrological regime, *Predation, *Stream biota, *Fish populations, Ecological distribution, Carp, Minnows, Invertebrates, Aquatic insects, Riffles, Benthic environment, Channel scour, Spawning, Trophic level, Chubs, Minnesota.

Descriptive and experimental approaches were used on Gould Creek, a first-order tributary of the Mississippi River in Minnesota, to assess the influence of (1) flow regime on the colonization dynamics and abundance of invertebrates and cyprinids, and (2) cyprinid predation on invertebrates and fishes. Stream flow varied annually during the 3-year (1984-1986) period. One dry year (1984) was followed by two wet years with prolonged elevated (nonscouring) discharge. The density of benthic and drifting invertebrates increased dramatically with elevated flow. Benthic riffle invertebrates in particular increased; the primary groups which increased in abundance were larval Hydropsychidae and Simuliidae. To assess directly the influence of flow regime on benthic insect densities, flow was manipulated in six subsections of a riffle and colonization of natural rock substrates monitored. Total insect abundance, especially the family Hydropsychidae, was higher under elevated (nonscouring) vs. low flow within 6-8 days; after 24 days insect abundance was three times as high under elevated flow. Cyprinid density also increased with elevated flow, particularly during spawning periods in spring, consisting mostly of older individuals. All cyprinids, except the creek chub, decreased in abundance 4-5 weeks after spring colonization, regardless of flow conditions and invertebrate abundance. These results suggest that (1) the hydrologic regime has broad and pronounced effects on the colonization dynamics and abundance of invertebrates and fishes in headwater streams, and (2) cyprinid predation has weaker but variable effects on the abundance of stream organisms. Predation intensity varies (a) over short temporal scales, because of the dynamic nature of flow regime and the rapid colonizing ability but short post-spawning persistence of cyprinids, (b) over small spatial scales, because of increased abundance of cyprinids in pool vs. riffle, (c) between invertebrate and vertebrate trophic levels because the creek chub is a relatively ineffective piscivore, and (d) between small and large fish because many minnows have a size refuge from creek chubs. (Author's abstract)
W89-10649

DYNAMICS AND CONTROL MECHANISMS IN A TROPICAL ZOOPLANKTON COMMUNITY (LAKE VALENCIA, VENEZUELA),
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
J. F. Saunders, and W. M. Lewis.
Ecological Monographs ECMOAG, Vol. 58, No. 4, p 337-353, December 1988. 6 fig, 7 tab, 82 ref. NSF Grants DEB76-04300, DEB78-05324, and DEB80-03883.

Descriptors: *Limnology, *Zooplankton, *Aquatic productivity, *Tropical regions, *Predation, *Eutrophic lakes, Copepods, Rotifers, Biomass, Algal growth, Primary productivity, Growth rates, Growth stages, Population dynamics, Food chains, Mixing, Carnivores, Herbivores, Venezuela.

The dynamics of zooplankton herbivores in Lake Valencia, Venezuela, were studied over a five-year interval. This eutrophic lake is large and warm-monomictic. Copepods were the dominant group; rotifers were more abundant than the cladocerans, which were not present in all years. Variation between years in herbivore biomass bore no statistical relationship to patterns in algal biomass. The average annual dry mass production of the herbivores was high, but less than expected given the high primary productivity of the lake. The annual ratios of production to biomass for individual species were well below the maxima expected for steady growth, and thus imply growth suppression. Annual overturn broke the coupling between predator and prey by causing extensive mortality in both herbivores and carnivores; herbivores recovered from this suppression more rapidly than carnivores. Herbivores followed three basic strategies for coexistence with their predators: matching predation losses by reproductive output; sustaining losses because the adult stage was subsidized by recruitment from earlier, less vulnerable development stages; or opportunistically becoming abundant only in response to a decline in the predator population. The opportunistic species were most abundant during the mixing season, which was the period of minimum abundance for the primary carnivore. Population data indicate that inadequate food resources also played a role. Growth suppression was the result of qualitative rather than quantitative inadequacy in the algal food base. The intensity of control by the two factors was strongly affected by abiotic factors associated with mixing events. Partial mixing provided brief respite from growth suppression for certain species (typically rotifers), but did not alter predation pressure. Annual overturn resulted in improvement of food quality, but because mortality of herbivores coincided with relaxation of predation, the herbivores were delayed in exploiting qualitative improvements in the food resources. Herbivores were thus controlled simultaneously by predation and quality of food resource. (Author's abstract)
W89-10650

DAPHNIA-PHYTOPLANKTON INTERACTIONS: DENSITY-DEPENDENT SHIFTS IN RESOURCE QUALITY,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. C. Kerfoot, C. Levitan, and W. R. DeMott.
Ecology ECOLAR, Vol. 69, No. 6, p 1806-1825, December 1988. 9 fig, 9 tab, 60 ref. NSF Grant 80-04654.

Descriptors: *Limnology, *Zooplankton, *Aquatic populations, *Daphnia, *Phytoplankton, *Mesotrophic lakes, *Algal growth, Flagellates, Seasonal depletion, Refractivity, Chlorophyll a, Biomass, Primary productivity, Water quality, Competition, Vermont.

In mesotrophic Lake Mitchell, Vermont, density fluctuations of Daphnia cause rapid shifts within algal assemblages, while total phytoplankton cell densities persist at comparable levels before and after grazer fluctuations. The rapidly shifting balance between naked flagellates and several digestion-resistant species is evident in both seasonal patterns and in enclosure experiments. The balance between flagellates and resistant species helps explain asymmetrical demographic responses of competing smaller bodied cladocerans to changes in Daphnia density. Shifts between refractory components and accessible, edible algae constitute a prime reason why general measures of phytoplankton (e.g., chlorophyll a, biomass, biovolume, primary productivity) may fail to reflect impacts of Daphnia fluctuations. Rapid changes in resource quality may also provide a simple explanation for why Daphnia's tendency to show unstable oscillatory dynamics in the laboratory is dampened in natural populations. (Author's abstract)
W89-10652

ROLE OF MACROINVERTEBRATES IN NITROGEN DYNAMICS OF A DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
N. B. Grimm.
Ecology ECOLAR, Vol. 69, No. 6, p 1884-1893, December 1988. 6 fig, 3 tab, 63 ref. NSF Grants DEB 80-04145 and BSR 84-06891.

Descriptors: *Macroinvertebrates, *Nitrogen cycle, *Deserts, *Streams, Excretion, Nitrogen compounds, Nitrogen removal, Snails, Insects, Predation, Ecosystems, Biomass, Ammonia.

Organismal nitrogen budgets (nitrogen ingested, egested, excreted, and utilized in production) were constructed for collector-gatherer macroinvertebrates and grazing snails of a Sonoran Desert stream. Twenty-seven percent of ingested nitrogen was utilized in insect tissue production, 9-31% was excreted as ammonia, and the remainder (42-64%) was egested. Of nitrogen utilized in production, only 26% resulted in increased standing stock during a 20-day successional period. The remainder was lost to predation and nonpredatory mortality (70%) or as emergent adult insects (4%). Snail excretion was 9-13%, and egestion was 26-39% of ingestion. Of nitrogen ingested by snails 50-68% was used in tissue production. As a percentage of nitrogen retained by the stream ecosystem, increased storage of nitrogen in insect biomass was 10%, insect emergence was 1%, and excretion recycled up to 70% of that amount back to the dissolved nitrogen compartment. Collector-gatherer macroinvertebrate influence on nitrogen dynamics, especially via recycling of excreted ammonia, increased over successional time. (Author's abstract)
W89-10653

RECREATION AND CONSERVATION ALONG THE METROPOLITAN TORONTO WATERFRONT, LAKE ONTARIO, CANADA,
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W89-10663

ALTERNATIVE APPROACH TO THE YEAST EXTRACT-NALIDIXIC ACID METHOD FOR DETERMINING THE PROPORTION OF METABOLICALLY ACTIVE AQUATIC BACTERIA,
Hull Univ. (England). Dept. of Applied Biology.
S. A. Al-Hadithi, and R. Goulder.
Letters in Applied Microbiology LAMIE7, Vol. 8, No. 3, p 87-90, March 1989. 2 fig, 1 tab, 7 ref.

Descriptors: *Culturing techniques, *Stream biota, *Aquatic bacteria, *Bacterial analysis, Metabolism, Particle size, Frequency distribution.

The yeast extract-malidixic acid method was applied to epiphytic and planktonic bacteria from an organically enriched water course. When metabolizing aquatic bacteria were determined by the conventional approach to the yeast extract-nalidixic acid method the apparent percentage of viable bacteria depended on the critical length beyond which cells were scored as viable. An alternative approach allowed the identification of an optimum critical length and the fixing of a lower limit to the true percentage of viable bacteria. (Author's abstract)
W89-10704

PRODUCTION AND RELEASE OF DIMETHYL SULFIDE FROM THE GREAT LAKES,
National Water Research Inst., Burlington (Ontario).
J. O. Nriagu, and D. A. Holdway.
Tellus TELLAL, Vol. 41B, No. 2, p 161-169, April 1989. 1 fig, 3 tab, 36 ref.

Descriptors: *Limnology, *Acid rain, *Sulfur compounds, *Great Lakes, *Sulfides, *Organic compounds, Microbial degradation, Plankton, Proteins, Diatoms, Spatial distribution.

Dimethyl sulfide has been detected in all the water samples from Lakes Superior, Erie and Ontario. The average concentrations in the surface waters were 5.2 nanograms/liter for Lake Superior, 16 nanograms/liter (June) and 7.3 nanograms/liter (August) for Lake Erie and 27 nanograms/liter (June) and 13 nanograms/liter (August) for Lake Ontario. The profiles in the water column and the seasonal variations (with highest concentrations following after the crash of spring diatom bloom) suggest that DMS production in these lakes stems primarily from the microbial decomposition of dead algal cells. Only a small fraction (<5%) of the sulfur used in planktonic protein synthesis is converted to DMS, however. The emissions of DMS to the atmosphere were calculated to be 107, 49, and 69 ton/year, respectively in Lakes Superior, Erie and Ontario. The biogenic sulfur emissions from the lakes are thus insignificant compared to the contributions from anthropogenic sources in the Great Lakes basin. (Author's abstract)
W89-10712

METHANE FLUX AND STABLE HYDROGEN AND CARBON ISOTOPE COMPOSITION OF SEDIMENTARY METHANE FROM THE FLORIDA EVERGLADES,
University of South Florida, St. Petersburg. Dept. of Marine Science.
R. A. Burke, T. R. Barber, and W. M. Sackett.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 329-340, December 1988. 8 fig, 3 tab, 63 ref. NASA grant NAGW 836.

Descriptors: *Wetlands, *Limnology, *Geochemistry, *Methane, *Florida, *Marshes, Organic matter, Sediments, Aquatic plants, Oxidation, Vegetation effects, Stable isotopes, Path of pollutants.

Methane flux and the stable isotopic composition of sedimentary methane were measured at four locations in the Florida Everglades system. Individual estimates of methane flux ranged over more than 3 orders of magnitude, from about 0.001 to 2.6 g CH4/sq m/day. Significant interstation differences in total methane flux were also observed and are judged most likely attributable to differences in the size and spacing of emergent aquatic vegetation, and possibly differences in the type (i.e, vascular plant versus algal) of organic matter incorporated into the sediments. On the basis of measurements presented here and by other investigators, the Everglades system appears to be a relatively weak source of atmospheric methane, probably contributing less than 0.5 Tg CH4/yr. Emergent aquatic plants appear to be capable of indirectly affecting the stable isotopic composition of sedimentary methane by stimulating methane oxidation via root aeration. A significant positive correlation between delta D-Ch4 and delta C13-CH4 was observed for samples collected from sediments covered by tall, dense stands of emergent plants. In contrast, a significant negative correlation between the delta D and delta C13 of sedimentary methane was observed for samples collected at an open water site where ebullition dominated methane transfer to the atmosphere. The mean delta C13 of sedimentary methane samples measure in the Everglades system (mean delta C13=-61.7 o/oo, s.d.=3.6 o/oo, n=51) is not significantly different from the estimated average delta C13 of all natural sources (-58.3 o/oo). The mean delta D of Everglades sedimentary methane (mean delta D=-293 o/oo, s.d.=14 o/oo, n=50) appears to be slightly less D-depleted than the estimated average methane (delta D=-360+or-30 o/oo) from all sources. (Author's abstract)
W89-10716

MEASUREMENTS AND INTERPRETATION OF DELTA-C13 OF METHANE FROM TERMITES, RICE PADDIES, AND WETLANDS IN KENYA,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2K.
W89-10717

METHANE PRODUCTION AND OXIDATION IN LAKES IMPACTED BY THE MAY 18,1980 ERUPTION OF MOUNT ST. HELENS,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W89-10718

METHANE FLUX FROM MINNESOTA PEATLANDS,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
P. M. Crill, K. B. Bartlett, R. C. Harriss, E. Gorham, and E. S. Verry.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 371-384, December 1988. 7 fig, 5 tab, 60 ref.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Wetlands, *Peat bogs, *Fens, *Minnesota, Soil temperature, Spatial distribution, Temporal distribution.

Northern (>40 deg N) wetlands have been suggested as the largest natural source of methane (CH4) to the troposphere. To refine our estimates of source strengths from this region and to investigate climatic controls on the process, fluxes were measured from a variety of Minnesota peatlands during May, June, and August 1986. Sites included forested and unforested ombrotrophic bogs and minerotrophic fens in and near the U.S. Department of Agriculture Marcell Experimental Forest and the Red Lake peatlands. Late spring and summer fluxes ranged from 11 to 866 mg CH4/sq m/day, averaging 207 mg CH4/sq m/day overall. At Marcell Forest, forested bogs and fen sites had lower fluxes (averages of 77 +or-21 mg CH4/sq m/day and 142 +or-19 mg CH4/sq m/day) than open bogs (average of 294 +or-30 mg CH4/sq m/day). In the Red Lake peatland, circumneutral fens, with standing water above the peat surface, produced more methane than acid bog sites in which the water table was beneath the moss surface (325 +or-31 and 102 +or-13 mg CH4/sq m/day, respectively). Peat temperature was an important control. Methane flux increased in response to increasing soil temperature. For example, the open bog in the Marcell Forest with the highest CH4 flux exhibited a 74-fold increase in flux over a three-fold increase in temperature. It is estimated that the methane flux from all peatlands north of 40 deg may be on the order of 70 to 90 Tg/yr though estimates of this sort are plagued by uncertainties in the areal extent of peatlands, length of the CH4 producing season, and the spatial and temporal variability of the flux. (Author's abstract)
W89-10719

ISOTOPIC COMPOSITION OF METHANE RELEASED FROM WETLANDS: IMPLICATIONS FOR THE INCREASE IN ATMOSPHERIC METHANE,
Washington Univ., Seattle. School of Oceanography.
For primary bibliographic entry see Field 5B.
W89-10720

METHANE FLUX TIME SERIES FOR TUNDRA ENVIRONMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. C. Whalen, and W. S. Reeburgh.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 399-409, December 1988. 7 fig, 2 tab, 39 ref. NASA grant NASW 841, RTOP 147-02-41-01.

Descriptors: *Geochemistry, *Biochemistry, *Methane, *Tundra, *Seasonal variation, Mosses, Path of pollutants.

Seasonal measurements of net methane flux were made at permanent sites representing important components of arctic tundra. The sites include Eriophorum tussocks, intertussock depressions, moss-covered areas, and Carex stands. Methane fluxes showed high diel, seasonal, intra site, and between site variability. Eriophorum tussocks and Carex dominated methane release to the atmosphere, with mean annual (+or-1 sigma) net methane fluxes of 8.05 +or-2.50 g CH4/sq m and 4.88 +or-0.73 g CH4/sq m, respectively. Methane fluxes from the moss sites and intertussock depressions were much lower (0.47 +or-0.16 and 0.62 +or-0.28 g CH4/sq m/yr. Over 90% of the mean annual methane flux from the Eriophorum, intertussock depressions, and Carex sites occurred between thaw and freeze-up. Some 40% of the mean annual methane flux from the moss sites occurred during winter. Composite methane fluxes for tussock tundra and Carex-dominated wet meadow tundra environments were produced by weighting measured component fluxes according to areal coverage. Tussock and wet meadow tundra account for an estimated global methane emission of 19-33 Tg/yr. (Author's abstract)
W89-10721

DIFFUSIVE FLUX OF METHANE FROM WARM WETLANDS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
T. R. Barber, R. A. Burke, and W. M. Sackett.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 411-425, December 1988. 6 fig, 7 tab, 76 ref. NASA grant NAGW 836.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Wetlands, *Air-water interfaces, Florida, Mangrove swamps, Organic matter, Lakes, Estuaries.

Diffusion of methane across the air-water interface from several wetland environments in south Florida was estimated from measured surface water concentrations using an empirically derived gas exchange model. The flux from the Everglades sawgrass marsh system varied widely, ranging from 0.18 +or-0.21 mol CH4/sq m/yr for densely vegetated regions to 2.01 +or-0.88 for sparsely vegetated, calcitic mud areas. Despite brackish salinities, a strong methane flux, 1.87 +or-0.63 mol CH4/sq m/yr, was estimated for an organic-rich mangrove pond near Florida Bay. The diffusive flux accounted for 23, 36, and 13% of the total amount of CH4 emitted to the atmosphere from these environments, respectively. The average dissolved methane concentration for an organic-rich forested swamp was the highest of any site at 12.6 microM; however, the calculated diffusive flux from this location, 2.57 +or-1.88 mol CH4/sq m/yr, was diminished by an extensive plant canopy that sheltered the air-water interface from the wind. The mean diffusive flux from four freshwater lakes, 0.77 +or-0.73 mol CH4/sq m/yr, demonstrated little temperature dependence. The mean diffusive flux for an urbanized, subtropical estuary was 0.06 +or-0.05 mol CH4/sq m/yr. (Author's abstract)
W89-10722

METHANE HYDRATES AND GLOBAL CLIMATE,
Geological Survey, Menlo Park, CA.
K. A. Kvenvolden.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 221-229, September 1989. 4 fig, 2 tab, 48 ref.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Arctic zone, *Permafrost, *Path of pollutants, Spatial distribution, Climatology, Model studies, Natural gas.

Methane hydrates are globally widespread in permafrost regions and beneath the sea in sediment of outer continental margins. The amount of methane sequestered in gas hydrates is probably enormous, but estimates of the amounts are speculative and range over three orders of magnitude (about 1,000 to 1000,000 gigatons). A question of current interest concerns the possible consequences of an addition of methane to the atmosphere from destabilized methane hydrates due to global warming. Models of greenhouse warming predict that climatic change will be greatest in the Arctic. Thus, if methane from destabilized gas hydrates contributes to greenhouse warming, this destabilization will most likely take place first in the Arctic, particularly in the shallow nearshore regions of the Arctic Ocean where offshore permafrost is found.

The process of permafrost warming and release of methane from gas hydrates may already be in progress, but the amount being released now and to be released in the 21st century is probably small. The positive feedback of this atmospheric methane on global climates will likely be minimal. (Author's abstract)
W89-10723

METHANE EFFLUX FROM THE PELAGIC REGIONS OF FOUR LAKES,
Geological Survey, Menlo Park, CA.
L. G. Miller, and R. S. Oremland.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 269-277, September 1988. 4 fig, 2 tab, 43 ref.

Descriptors: *Limnology, *Biochemistry, *Geochemistry, *Methane, *Model studies, *Meromictic lakes, *Saline lakes, Path of pollutants, Pelagic regions, Oxidation.

Methane emission to the atmosphere was studied in the deepest, central (pelagic) regions of one freshwater and three meromictic, alkaline saline lakes. The range of methane emissions was 0.0004 to 2.916 mmol/sq m/hr (n=41). Outward flux was dominated by bubble ebullition only in the freshwater lake. Diffusive gas exchange was the sole mechanism of transfer in the meromictic lakes, and flux from these lakes was equivalent to or lower than that from the freshwater lake during its periods of ebullition. A comparison of measured flux with flux calculated using a model of gas exchange in Mono Lake suggested that floating chambers provide reasonable estimates of the magnitude of methane emissions from diffusion-dominated systems. (Author's abstract)
W89-10726

POTENTIAL METHANE PRODUCTION AND METHANE OXIDATION RATES IN PEATLAND ECOSYSTEMS OF THE APPALACHIAN MOUNTAINS, UNITED STATES,
West Virginia Univ., Morgantown. Dept. of Biology.
J. B. Yavitt, G. E. Lang, and D. M. Downey.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 253-268, September 1988. 7 fig, 4 tab, 41 ref. NASA grant NAGW-842.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Peat bogs, *Wetlands, *Seasonal variation, Oxidation, Microbial degradation, Pore water, Carbon dioxide.

Potential rates of methane production and carbon dioxide production were measured on 11 dates in 1986 in peat from six plant communities typical of moss-dominated peatlands in the Appalachian Mountains. Annual methane production ranged from 2.7 to 17.5 mol/sq m, and annual carbon dioxide production ranged from 30.6 to 79.0 mol/sq m. The wide range in methane production values among the communities found within a single peatland indicates that obtaining one production value for a peatland may not be appropriate. Low temperature constrained the potential for methane production in winter, while the chemical quality of the peat substrate appears to control methane production in the summer. Methane oxidation was measured throughout the peat profile to a depth of 30 cm. Values for methane oxidation ranged from 0.08 to 18.7 microM/hr among the six plant communities. Aerobic methane-oxidizing bacteria probably mediated most of the activity. On a daily basis during the summer, between 11 and 100% of the methane produced is susceptible to oxidation within the peat column. Pools of dissolved methane and dissolved carbon dioxide in pore waters were less than 0.2 and less than 1.0 mol/sq m, respectively, indicating that methane does not accumulate in the pore waters. Peatlands have been considered as an important source of biologically produced methane. Despite the high rates of methane production, the high rates of methane oxidation dampen the potential emission of methane to the atmosphere. (Author's abstract)
W89-10727

CARBON ISOTOPIC COMPOSITION OF METHANE IN FLORIDA EVERGLADES SOILS AND FRACTIONATION DURING ITS TRANSPORT TO THE TROPOSPHERE,
North Carolina Univ. at Chapel Hill. Marine Sciences Program.
J. P. Chanton, G. G. Pauly, C. S. Martens, N. E. Blair, and J. W. H. Dacey.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 245-252, September 1988. 1 fig, 5 tab, 47 ref. NASA grant NAGW-593.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Wetlands, *Florida, Organic carbon, Soil water, Bubbles, Air-earth interfaces, Path of pollutants, Stable isotopes.

The delta-C13 stable carbon isotopic composition of methane collected in bubbles from the submerged soils of specific environments within the Everglades wetland in southern Florida varied from -70 o/oo to -63 o/oo across the system while organic carbon in the soils and dominant plants varied from -28 o/oo to -25 o/oo. A methane isotopic budget based upon the soil bubble isotope data and published methane flux measurements predicted a flux of isotopic composition -65 o/oo, a value 5-10 o/oo more depleted in C13 than the isotopic composition of methane emanating to the atmosphere. Emergent aquatic plants, which are known to be active methane transporters between soil and atmosphere in this ecosystem, were found to transport methane of delta-C13 content up to 12 o/oo different from the delta-C13 content of the soil methane bubble reservoir. Methane C14 content at one site was determined to be 108.6% modern (delta-C14=83+or-10 o/oo). (Author's abstract)
W89-10728

SOURCES OF ATMOSPHERIC METHANE IN THE SOUTH FLORIDA ENVIRONMENT,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 5B.
W89-10729

EVALUATING CUMULATIVE EFFECTS ON WETLAND FUNCTIONS: A CONCEPTUAL OVERVIEW AND GENERIC FRAMEWORK,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 6G.
W89-10770

CUMULATIVE IMPACTS ON WETLANDS: LINKING SCIENTIFIC ASSESSMENTS AND REGULATORY ALTERNATIVES,
Environmental Protection Agency, Washington, DC. Office of Wetlands Protection.
For primary bibliographic entry see Field 6G.
W89-10771

CONCEPTUAL FRAMEWORK FOR ASSESSING CUMULATIVE IMPACTS ON THE HYDROLOGY OF NONTIDAL WETLANDS,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W89-10772

EVALUATING CUMULATIVE EFFECTS OF DISTURBANCE ON THE HYDROLOGIC FUNCTION OF BOGS, FENS, AND MIRES,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W89-10773

EVALUATING THE CUMULATIVE EFFECTS OF ALTERATION ON NEW ENGLAND WETLANDS,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 6G.
W89-10774

CUMULATIVE IMPACTS ON WATER QUALITY FUNCTIONS OF WETLANDS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W89-10775

IMPACTS OF FRESHWATER WETLANDS ON WATER QUALITY: A LANDSCAPE PERSPECTIVE,
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 6G.
W89-10777

NATURE OF CUMULATIVE IMPACTS ON BIOTIC DIVERSITY OF WETLAND VERTEBRATES,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
For primary bibliographic entry see Field 6G.
W89-10778

ISSUES AND APPROACHES IN ASSESSING CUMULATIVE IMPACTS ON WATERBIRD HABITAT IN WETLANDS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 6G.
W89-10779

SOME THOUGHTS ON USING A LANDSCAPE FRAMEWORK TO ADDRESS CUMULATIVE IMPACTS ON WETLAND FOOD CHAIN SUPPORT,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 6G.
W89-10780

DEVELOPING THE SCIENTIFIC BASIS FOR ASSESSING CUMULATIVE EFFECTS OF WETLAND LOSS AND DEGRADATION ON LANDSCAPE FUNCTIONS: STATUS, PERSPECTIVES, AND PROSPECTS,
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 6G.
W89-10783

EXPERIMENTAL EVALUATION OF EFFECTS OF ZOOPLANKTON BIOMASS AND SIZE DISTRIBUTION ON ALGAL BIOMASS AND PRODUCTIVITY IN THREE NUTRIENT-LIMITED LAKES,
California Univ., Davis. Div. of Environmental Studies.
J. J. Elser, and N. A. MacKay.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 481-496, February 1989. 4 fig, 4 tab, 40 ref. NSF Grants BSR-83-08918 and BSR-86-06271.

Descriptors: *Lakes, *Zooplankton, *Algae, *Biomass, *Productivity, *Limnology, *Limiting nutrients, Enrichment, Photosynthesis, Chlorophyll, Algal growth, Primary productivity, Population density, Michigan.

Mesocosm experiments were performed in Peter, Paul, and Tuesday Lakes, Michigan, to evaluate responses of algal chlorophyll, primary productivity (PPR), and chlorophyll-specific PPR (photosynthetic capacity) to manipulations of zooplankton biomass and size. In all experiments, nutrient enrichment led to increased growth and higher photosynthetic capacity, indicating that the phytoplankton in these lakes were nutrient-limited. In experiments which exposed phytoplankton to a 32-fold range of zooplankton biomass, chlorophyll decreased significantly ($p < 0.05$), while PPR was unchanged. As a result, specific PPR increased significantly with increasing zooplankton biomass, indicating an improvement in algal physiological status and the occurrence of compensatory growth in response to increased grazing pressure and higher nutrient regeneration. In an experiment which manipulated the zooplankton size distribution at two constant levels of zooplankton biomass (one-fourth and twice ambient zooplankton densi-

ty), no significant algal responses to zooplankter size occurred at the low biomass level; however, at the high level, chlorophyll decreased and specific PPR increased with increasing average zooplankter size. These results emphasize the close coupling between zooplankton grazing and nutrient regeneration and algal nutrient uptake and growth in such nutrient-deficient systems. (Author's abstract)
W89-10784

THREE TROPICAL CRATER LAKES IN BALI (INDONESIA): A REEXAMINATION OF SOME LAKES VISITED BY THE GERMAN SUNDA EXPEDITION IN 1929,
Helsinki Univ. (Finland). Dept. of Limnology.
P. Lehmusluoto, and B. Mahbub.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 537-553, February 1989. 6 fig, 6 tab, 10 ref.

Descriptors: *Limnology, *Lakes, *Craters, *Tropical regions, *Indonesia, Catchment areas, Water temperature, Hydrogen ion concentration, Color, Eutrophication, Silt, Suspended sediments, Sedimentation, Secchi disks, Phytoplankton.

Lakes Batur, Bratan, and Buyan were visited in 1977. Lakes Batur and Bratan had been visited some 48 years earlier by a German limnological expedition. Considerable progress has been made in the development of analytical methods during this period. However, very little change in the lakes over the years could be detected although human activity has increased in their respective catchment areas. The only significant differences noted refer to the temperature in lakes Batur and Bratan and the pH and color of Lake Bratan. The pH rise of about 0.5 units of Lake Bratan may be attributed to cultural eutrophication. A pH-value of 7.6 was also measured at 1 meter in 1974 in Lake Buyan, while in this study in 1977 pH ranged from 6.5 to 7.0 in the entire water column. In 1929 the color of Lake Bratan was brown-green. In this study the color was greenish. This may be explained by the fact that the earlier observations were made at the end of the rainy season when silt surface runoff from the drainage area still colored the water. In this study, at the end of the dry season, the water had cleared up through sedimentation, so that its 'natural' greenish color could be observed. The Secchi disk reading in 1974 was 4.0 m. The lower Secchi disk reading (1.5 m) in 1929 may have been caused by abundant phytoplankton or by high silt concentration. (Shidler-PTT)
W89-10785

ENCRUSTING ALGAL ASSEMBLAGES IN A MEDITERRANEAN RIVER BASIN,
Barcelona Univ. (Spain). Dept. de Ecologia.
S. Sabater.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 555-573, February 1989. 5 fig, 6 tab, 37 ref. CAICYT Project 478/81.

Descriptors: *Stream biota, *Algae, River basins, Species composition, Cyanophyta, Chlorophyta, Flow velocity, Hardness, Nutrient requirements, Salinity, River mouth, Water pollution effects, Spain.

Encrusting algae are strikingly developed in some stretches and tributaries of the river Ter, situated in Catalonia, NE Spain. Twenty-eight sites located in the siliceous headwaters and in some siliceous and calcareous streams and springs were studied intensively. Cyanophyceae and chlorophyceae were dominant is such assemblages. In the headwaters an assemblage of Chamaesiphon polonicus and Homeothrix janthina was established in high-velocity, clean, cold waters. In some fast-flowing streams, a thick, layered crust was formed where Schizothrix spp. were the most abundant species. When the water velocity was less important, Gongrosira incrustans and Phormidium incrustatum were abundant. Downstream, when slope lessened and salinity gradually increased the community changed to a poorer one, where Pleurocapsa minor was the most abundant species. In forested calcareous streams Chantransia and Cladophora were very abundant and allowed the development of a micro-encrusting community. A poor but diverse community grew in a little harbor at the mouth of the river. River substrata, water velocity, degree of shading, water hardness, and nutrient concentration seemed to be the most important parameters in assemblage distribution in the river basin. Eutrophic conditions and pollution limit their development. (Shidler-PTT)
W89-10786

ECOLOGICAL ASPECTS OF THE FISH FAUNA IN THREE PORTUGUESE RESERVOIRS,
Oslo Univ. (Norway). Lab. for Freshwater Ecology and Inland Fisheries.
A. Brabrand, and S. J. Saltveit.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 575-589, February 1989. 9 fig, 6 tab, 20 ref.

Descriptors: *Fish populations, *Reservoirs, *Ecological distribution, *Portugal, Fish diets, Fish behavior, Growth, Species diversity, Species composition, Sunfish, Carp, Eutrophication, Zooplankton, Daphnia.

Growth, age, feeding, length/weight regressions, fish-species interactions, and behavior for the most abundant fish species in Divor, Montargil, and Maranhao Reservoirs are presented. During the investigation period, stratification was not yet established and well-oxygenated water was present at all depths in the three reservoirs. In all three reservoirs the number of fish species in the pelagic zone was low. Sunfish (Lepomis gibbosus) dominated completely in Divor and Montargil, while carp (Cyprinus carpio) and nase (Chondrostoma polylepis) dominated in Maranhao. Sunfish showed a general day-pelagic activity, confirmed by high zooplankton consumption. As expected, the spined loach, Cobitis taenia, was caught in Divor; this shallow lake allows this species to survive in the substrate even in highly eutrophic conditions, due to acceptable oxygen levels and substrate consistency. Largemouth bass, Micropterus salmoides, in Divor, fed on sunfish of the 0+ age class, probably when sunfish moved into the littoral zone at night. In the Maranhao reservoir, carp and nase were both planktivorous, their gut contents being completely dominated by zooplankton (>98% Daphnia). In Montargil sunfish were planktivorous, mainly feeding on Daphnia. In Divor, a shift in zooplankton dominance from Daphnia longispina to the more predation-resistant species Bosmina longirostris, and the high planktivorous tendency of sunfish in general, indicate that this species is an important factor regulating zooplankton abundance and species composition. (Author's abstract)
W89-10787

SUMMER LIMNOLOGY AND FISHERIES OF HIGH MOUNTAIN LAKES OF KASHMIR HIMALAYAS,
Central Inland Fisheries Research Inst., Barrackpore (India).
K. K. Vass, A. Wanganeo, H. S. Raina, D. P. Zutshi, and R. Wanganeo.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 603-619, February 1989. 1 fig, 5 tab, 39 ref.

Descriptors: *Mountain lakes, *Oligotrophic lakes, *Limnology, *Lake fisheries, *Himalayan Mountains, Lake morphometry, Physicochemical properties, Oxygen depletion, Calcium, Biological properties, Phytoplankton, Rotifers, Copepods, Benthic fauna, Fish, Trout, Sport fishing, Water pollution prevention.

Physicochemical and biological properties of twelve lakes at altitudes > 3000 m were investigated during the summer ice-free period. The lakes showed both cold-monomictic and dimictic thermal behavior. No oxygen depletion at the bottom was noted. Calcium was the dominant cation with a Ca:Mg ratio of 6:1. Reasonable phytoplankton populations were recorded with Bacillariophyceae dominating. Among zooplankton rotifers were dominant, while copepods included palaearctic elements like Arctodiaptomus parvispinus. Zoobenthos consisted mostly of Tendipex and Brachycentrus at an average density of 74 individuals/sq m. An endemic fish (Diptychus maculatus) population was found only in Gadsar and Zumsar Lakes. These lakes might be remnants of ancient larger water bodies in which Diptychus maculatus was thriving during palaearctic fish migration between Central Asia and Kashmir. In four other lakes, exotic brown trout (Salmo trutta fario) were introduced four decades ago. The morphometric, physicochemical, and biological characteristics of these mountain lakes clearly differentiate them from forest and valley lakes. The mountain lakes are still oligotrophic but, in some, slightly elevated nutrient levels indicate the impact of undesirable human influence. The lakes with sports fisheries should be available to anglers but protected against the deterioration that human interference can easily induce. Continued monitoring of these lakes should be planned in order that symptoms of incipient eutrophication, if they appear, may be detected as early as possible. (Shidler-PTT)
W89-10788

DISTRIBUTION OF ZOOBENTHOS IN LITTORAL OF TWO LAKES DIFFERING IN TROPHY,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
R. Kornijow.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 35, No. 2, p 185-195, 1988. 2 fig, 1 tab, 26 ref.

Descriptors: *Littoral environment, *Benthic fauna, *Trophic level, *Limnology, *Distribution patterns, *Lake classification, *Mesotrophic lakes, *Eutrophic lakes, *Species composition, Aquatic habitats, Biomass, Population density, Water depth, Poland, Water pollution effects.

The occurrence and distribution of littoral zoobenthos was evaluated in mesotrophic Piaseczno Lake and eutrophic Glebokie Lake in eastern Poland to determine their dependence on trophic states. The material was collected at 1-mo. intervals from May to November 1980 and 1983. In the mesotrophic lake, the benthos inhabiting dissimilar types of littoral habitats and various depths differed mainly in qualitative composition and dominance structure. In the eutrophic lake, bottom fauna occurring in various types of littoral habitat differed mostly in density and biomass; the lake was characterized by reduction of the number of species in benthos with an increase in depth. Mean density and biomass of benthos were many times lower for the mesotrophic lake than for the eutrophic lake. For both lakes there were no significant differences between both years of studies in the species composition, density, and biomass of bottom fauna. (fish-PTT)
W89-10791

INVERTEBRATE COMMUNITY IN THE LITTORAL-REGULATED AREA OF A HYDROELECTRIC LAKE-RESERVOIR (LAKE CAMPOTOSTO, CENTRAL ITALY),
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
L. Mastrantuono.
Rivista di Idrobiologia RIIDBN, Vol. 26, Nos. 1-3, p 17-32, 1987. 2 fig, 7 tab, 32 ref.

Descriptors: *Limnology, *Littoral environment, *Hydroelectric plants, *Water level fluctuations, *Thermal pollution, *Species diversity, *Lakes, Macrophytes, Crustaceans, Oligochaetes, Insects, Environmental control, Oligotrophy, Mesotrophy, Italy, Water pollution effects, Invertebrates.

Data on meio--and macrozoobenthos associated with submerged macrophytes in a hydroelectric lake reservoir are reported. The fauna was composed of 16 zoological groups, including 70 taxa. Crustacea and Oligochaeta were the dominant groups, followed by Nematoda, Chironomidae, and Hydracarina. The community was characterized by: (a) absence of several zoological groups typical of littoral lacustrine zones; (b) qualitative impoverishment in the marginal area (0-4 meters of depth); (c) low diversification and abundance of Insecta; (d) presence of species frequently associat-

ed with small basins and temporary waters. This structure can be partially related to the water-level fluctuations and thermal conditions that constitute the environmental factors, especially in the littoral. A relatively high number of taxa, high values of diversity index, presence, and relative abundance of several macrofilterers cladocerans are indicative of ano-meso trophic status in littoral areas of the lake. (Author'sract)
W89-10794

ECOLOGY OF FRESHWATER NEMATODES: A REVIEW (A BADAN NAD EKOLOGIA NICIENI W WODACH SLODKICH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5A.
W89-10802

CASCADING EFFECTS IN LAKE ECOSYSTEMS: THE ROLE OF DIEL VERTICAL MIGRATIONS OF ZOOPLANKTON (EFEKTY KASKADOWE W EKOSYSTEMACH JEZIORNYCH: ZNACZENIE DODOWYCH MIGRACJI ZOOPLANKTONU),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. Lampert.
Wiadomosci Ekologiczne WEKLAF, Vol. 34, No. 2, p 123-141, 1988. 9 fig, 49 ref. English summary.

Descriptors: *Limnology, *Lakes, *Zooplankton, *Food chains, *Ecosystems, *Trophic level, *Vertical distribution, Algal growth, Migration, Aquatic productivity, Adaptation, Metabolism, Daphnia, Copepods, Plankton, Fish, Biomass, Grazing, Euphotic zone, Mathematical models, Primary Productivity, West Germany, Poland.

Herbivorous zooplankton species occupy a central position in pelagic food webs since they play an important role in structuring algal communities and, at the same time, provide food for higher trophic levels. Consequently, the commonly observed diel vertical migrations of zooplankton must affect the food webs by creating diel rhythms of algal mortality and reducing zooplankton production. Hypotheses on the adaptive value of diel vertical migrations are discussed. Little evidence is available for the validity of hypotheses proposing a metabolic or demographic advantage of migrating over nonmigrating animals. However there is evidence from two Daphnia species in Lake Constance and from Cyclops in Polish lakes that diel vertical migration is a mechanism for avoiding consumption by planktivorous fish. Diel shifts of zooplankton biomass cause considerable quantitative and qualitative fluctuations of grazing in the euphotic zone of lakes. The mortality of 'edible' algae is low during day and high at night. The algae can grow unimpeded during the day, but are harvested at night. Mathematical models show that this rhythm enhances primary production. Thus, planktivorous fish create effects cascading through the whole ecosystem structure from the highest to the lowest trophic level. (Author's abstract)
W89-10804

BIOMANIPULATION IV: DENSITY AND FEEDING ACTIVITY OF PLANKTIVOROUS FISH (BIOMANIPULACJA. IV: ZAGESZCZENIE I AKTYWNOSC POKARMOIVA RYB PLANKTONOZERAYCH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W89-10805

BINDING OF THREE PCB CONGENERS TO DISSOLVED ORGANIC CARBON IN FRESHWATERS,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W89-10810

SAMPLING STRATEGIES FOR WATER QUALITY MONITORING IN LAKES: THE EFFECT OF SAMPLING METHOD,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7A.
W89-10824

RECLAMATION OF ACID WATERS USING SEWAGE SLUDGE,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5G.
W89-10826

CONCEPTUAL MODEL OF GENETIC REGULATION OF MERCURY BIOGEOCHEMICAL CYCLING,
Electric Power Research Inst., Palo Alto, CA.
For primary bibliographic entry see Field 5G.
W89-10834

SEDIMENT ACCUMULATION AND ITS EFFECTS ON A MISSISSIPPI RIVER OXBOW LAKE,
Agricultural Research Service, Oxford, MS.
For primary bibliographic entry see Field 2J.
W89-10841

PEAT DEPOSIT WATER QUALITY IN LAKE ISTOKPOGA, FLORIDA, U.S.A.,
Seminole Electric Cooperative, Inc., Tampa, FL.
M. Roddy, and M. Tomlinson.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 41-50, January/February 1989. 1 fig, 6 tab, 6 ref.

Descriptors: *Lakes, *Water quality, *Florida, *Peat, Monitoring, Environmental protection, Licensing, Sampling, Water analysis, Interstitial water, Biological oxygen demand, Chemical oxygen demand, Dissolved oxygen, Suspended solids, Color, Optical properties, Nitrogen, Phosphorus, Calcium, Magnesium, Potassium, Iron, Lake Istokpoga, Baseline studies.

In 1983, water quality monitoring was conducted on peat deposits in Highlands County, FL. The monitoring objective was to provide initial data on the water quality in the area in order to identify potential problems with environmental licensing of peat harvesting operations on these deposits. The investigation included sampling for in situ and laboratory water analyses, peat core analyses, elutriate tests, and interstitial water quality analyses. The general trends evident from the data are that biological oxygen demand and chemical oxygen demand (and the resulting dissolved oxygen) may change from the control and harvest peatlands, but not consistently. In addition, total suspended solids, organic color, total nitrogen, and total phosphorus concentrations appear to be elevated under disturbed conditions. For metals, the major cations (Ca, Mg, K, Fe) may show an increase under disturbed conditions vs. control. For the remaining metals, some increases may occur, but the changes are essentially unpredictable. (Author's abstract)
W89-10842

INSTITUTIONAL ASPECTS OF LAKE MANAGEMENT,
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
S. M. Born, and C. Rumery.
Environmental Management EMNGDC, Vol. 13, No. 1, p 1-13, January/February 1989. 1 fig, 1 tab, 91 ref.

Descriptors: *Institutional constraints, *Water management, *Lakes, Jurisdiction, Legal aspects, Economic aspects, Social aspects, Public policy, Public opinion, Wisconsin.

The major barriers to successful lake management are institutional. However, in contrast to the technical and limnological dimensions of lake management, the institutional aspects of managing lakes have received little attention. The institutional factors that are important for successful lake management outcomes are: overlapping areal jurisdiction among governmental units, fragmented functional program responsibilities, ineffective coordination, limited authority, financial constraints, private sector roles, and inadequate public awareness and consensus. The range of typical institutional problems confronting lake management are well illustrated through experiences from the state of Wisconsin. Because lake management programs with institutional shortcomings rarely realize their goals, it is critical to assimilate, evaluate, and apply our experience to date with the institutional arrangements necessary to effectively manage lake resources. (Author's abstract)
W89-10845

COMPOSITION AND DISTRIBUTION OF THE MACROZOOBENTHOS OF THE RIVER STRUMA (C'STAV I RAZPREDELENIE NA MAKROZEESBENTOSA),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
S. S. Islam, Y. I. Uzunov, and S. G. Kovachev.
Hydrobiology HYDRB8, Vol. 28, p 15-35, 1986. 4 tab, 21 ref. English summary.

Descriptors: *Struma River, *Bulgaria, *Benthos, *Water pollution control, *Stream biota, Seasonal variation, Benthic fauna, Species composition, Species diversity, Industrial wastes.

The Struma River in Bulgaria had been subjected to adverse impacts of suspended substances of industrial origin that strongly suppressed the development of the zoobenthos. That impact was removed in 1974-75 when a new ecological situation was created in the river that permitted the some of the basic tendencies of the regeneration process of macrozoobenthic communities to be investigated. A study conducted during 1980-1984, when the process was in an advanced stage, established that along with the stabilization of the river environment, its benthic fauna became considerably enriched, both qualitatively and quantitatively. Of the 263 species found, 132 of them are reported as new for the river. A correlation was established between the ecological characterization of the leading species in the macrozoobenthos and the dominant B-mesosaproby in a broad part of the river. The benthos was dominated by periphytophilous and lithorheophilous naidids, mayflies, stoneflies, chironomides, etc. Under the conditions of a relatively steady saprobiological situation, the seasonal phenomena are more distinctly demonstrated in the occurrence and distribution of the species. It is assumed that the river has already established a constant composition of the macrozoobenthos and that further enrichment will be from insufficiently studied groups and some rare or specialized species. (Author's abstract)
W89-10855

KINETICS OF ENVIRONMENTAL AQUATIC PHOTOCHEMISTRY: THEORY AND PRACTICE,
For primary bibliographic entry see Field 2K.
W89-10940

WATER QUALITY OF NORTH CAROLINA STREAMS.
For primary bibliographic entry see Field 5B.
W89-10942

FRESHWATER ECOSYSTEMS: MODELLING AND SIMULATION,
Ceskoslovenska Akademie Ved, Ceske Budejovice. Inst. of Landscape Ecology.
M. Straskraba, and A. H. Gnauck.
Elsevier Science Publishers, New York. Developments in Environmental Modelling, No. 8, 1985. 309 p.

Descriptors: *Ecosystems, *Aquatic environment, *Model studies, Simulation analysis, Mathematical models, Theoretical analysis, Stochastic process, Thermodynamics, Systems analysis, Optimization.

Three currently held techniques for mathematically modeling ecological systems are: (1) the stochastic black-box methodology (application of classical systems theory); (2) the deterministic simulation methodology (application of classical theoretical

process studies to ecosystems); and (3) the cybernetic methodology (treatment of an ecosystem as a self-optimizing system). Another trend is the use of (irreversible) thermodynamics and the application of this theory to ecological systems. Part I of this text begins with a brief introduction to the principles of systems theory and its application to ecosystems and provides a summary of various methods of systems analysis. In Part II, emphasis is laid on the pelagic processes in standing water, characterized by relatively uninvolved structures from which models can be readily developed. Part III describes applications of the technique of modeling to solutions of theoretical and practical problems, with the different methods and objectives of modeling described in previous chapters. More recent developments in the methods and theory of ecosystem modeling are covered in Part IV. New methodical currents are mentioned, which might assume growing importance in the future. (Lantz-PTT)
W89-10959

INFORMATION NEEDS-AQUATIC,
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
For primary bibliographic entry see Field 5B.
W89-10970

WETLAND MODELLING.
Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. 227 p. Edited by William J. Mitsch, Milan Straskraba, and Sven E. Jorgensen.

Descriptors: *Estuaries, *Bogs, *Swamps, *Limnology, *Wetlands, *Model studies, *Ecosystems, *Salt marshes, Saline water, Marshes, Reservoirs, Lakes, Coastal waters, Meadows.

The study of wetlands is a relatively new field and the modeling of these systems is still in its formative stages. A global view was taken of wetlands in this book, not only by including a wide geographic distribution of wetlands, but also by including papers on both freshwater and saltwater wetlands. Wetlands are defined as systems intermediate between aquatic and terrestrial ecosystems, and include ecosystems under a wide range of hydrologic and ecologic conditions. The wetland types discussed in this book reflect that heterogeneity, ranging from intermittently flooded wet meadows to permanently flooded shallow reservoirs and lakes. Also included are modeling examples from coastal salt marshes, shallow estuaries, mesotrophic bogs, reed swamps, forested swamps, and regional wetlands. (See W89-10976 thru W89-10985) (Lantz-PTT)
W89-10975

HYDROLOGIC PROCESSES FOR MODELS OF FRESHWATER WETLANDS,
National Audubon Society, Naples, FL. Ecosystem Research Unit.
M. J. Duever.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 9-39, 10 fig, 53 ref. NSF Grant DEB 76-12292.

Descriptors: *Limnology, *Hydrology, *Model studies, *Wetlands, Hydrologic models, Groundwater level, Water table, Topography, Precipitation, Evapotranspiration, Groundwater movement, Air circulation, Aeration zone, Shallow water, Hydrologic systems.

The processes of a conceptual hydrologic model of a freshwater wetland are reviewed in detail. The unique hydrologic characteristic of wetlands is their narrow range of water table fluctuation above and below the ground surface which is dependent upon regional climatic and topographic characteristics and local site characteristics (microtopography, soil, vegetation) that create the necessary water depths and durations of inundation. The dominant processes controlling the distribution of water include atmospheric circulation, precipitation, evapotranspiration, and surface and groundwater flows. Surface and groundwater flows involve different portions of the same water mass. This water mass can be subdivided into surface water and three groundwater components: an unsaturated zone above the water table, an unconfined saturated zone below the water table, and a confined saturated zone below an impermeable aquiclude. One or another of these subdivisions may not exist at some sites or at different times at the same site. Most hydrologic differences among the various types of wetlands and shallow water bodies are of degree rather than of kind. (See also W89-10975) (Author's abstract)
W89-10976

SPATIALLY DISTRIBUTED MODEL OF RAISED BOG RELIEF,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
G. A. Alexandrov.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 41-53, 6 fig, 12 ref.

Descriptors: *Geomorphology, *Limnology, *Bogs, *Model studies, *Mathematical models, Hydrologic models, Wetlands, Mathematical studies, Rainfall, Simulation analysis, Differential equations, Equilibrium.

The cupola-like shape of a bog surface is usually explained within the framework of hydrology theory. Some propositions of this theory are used to construct a simulation model of bog growth. The model consists of two nonlinear partial differential equations. Analytical investigations have shown that there is a 'smooth' convex equilibrium state. 'Non-smooth' equilibrium states, which may be interpreted as the ridge-pool complex, are also available. The analysis of the relationship between the bog height and its diameter, based on rich empirical material (300 raised bogs), showed that there exists a limiting height of the bog dome, which is never exceeded even in the largest bogs. The existence of this limiting height of the dome may be stipulated by the fact that as the diameter grows, steady state, is attained at lower values of effective rainfall. On the other hand, the steady state of the ridge-hollow-complex type needs a smaller height of the bog dome for the outflow of the same amount of effective rainfall, due to a higher water flow in the hollows. (See also W89-10975) (Lantz-PTT)
W89-10977

INTERFERENCE BETWEEN MOSSES AND TREES IN THE FRAMEWORK OF A DYNAMIC MODEL OF CARBON AND NITROGEN CYCLING IN A MESOTROPHIC BOG ECOSYSTEM,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
D. O. Logofet, and G. A. Alexandrov.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 55-66, 4 fig, 1 tab, 16 ref.

Descriptors: *Mesotrophy, *Limnology, *Model studies, *Mosses, *Trees, *Bogs, *Carbon, *Mathematical models, *Nitrogen, *Cycling nutrients, Wetlands, Ecosystems, Organic matter, Vegetation, Forests, Succession.

Based upon a complete balance scheme for the organic matter and nitrogen cycles through the ecosystem of a mesotrophic (transitional) bog, a series of mathematical models is developed to see those trends in the evolution of the ecosystem which are caused by quantitative regularities of cycling. The most advanced, dynamic model of that series describes cycling through five aggregated compartments (trees, dwarf shrubs, grasses, mosses, and litter) and takes into account, along with competition for mineral nutrients, these two phenomena: (1) a weakness of plants under nitrogen starvation, and (2) an increase in litter decomposition in response to an increase in the nitrogen content of dead organic matter. Inclusion of the interference effect between trees and mosses in the model has not changed the principal conclusion that the tendency in evolution of the given transitional bog is towards a forest phase. (See also W89-10975) (Author's abstract)
W89-10978

PRODUCTIVITY-HYDROLOGY-NUTRIENT MODELS OF FORESTED WETLANDS,
Ohio State Univ., Columbus. School of Natural Resources.
W. J. Mitsch.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 115-132, 7 fig, 4 tab, 21 ref.

Descriptors: *Productivity, *Hydrology, *Swamps, *Limnology, *Forest wetlands, *Nutrients, *Model studies, Hydrologic models, Primary productivity, Flow profiles, Phosphorus, Biomass, Hydrologic systems, *Forest watersheds, Cycling nutrients, Forest hydrology, *Wetlands.

Modeling of forested wetlands depends on an understanding of the effects of hydrology and nutrient conditions on the primary productivity of the wetland ecosystem. Several studies, done over a decade and a half in the eastern half of the United States, suggest that flow-through forested wetlands are most productive and sluggish forested wetlands the least. Some investigators have attempted to translate these general findings into mathematical statements or other quatitative relationships. These quantifications include statistical relationships of primary productivity as a function of hydrology and/or nutrient inflow, and parabolic curves depicting productivity as a function of a hydrologic varialbe (i. e. water depth, depth to water table, or flow-through conditions). A preliminary forested wetland model, which simulates the influence of hydrology and nutrient conditions on wetland productivity, illustrates highest productivity with pulsing hydrology and least with sluggish, low nutrient conditions. Further analysis of forested wetlands and the chemistry of their watersheds may prove that it may be more important to describe the wetlands as 'clay' or 'silt' dominated watersheds, and to describe the nutrients carried into the wetland as available or non-available (as particulate and/or organic P). The model says nothing about the role of detritus on nutrient retention, and neither uptake nor recycling of nutrients by the plants is considered. This may be fairly reasonable however, as the trees have a considerale supply of nutrients, and uptake or recycling should not have any significant impact on the storage of available nutrients. The model does not include other biotic components of the ecosystem, although the biomass storage conceivably includes all of the biotic components. (See also W89-10975) (Lantz-PTT)
W89-10981

MODELLING NUTRIENT RETENTION BY A REEDSWAMP AND WET MEADOW IN DENMARK,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Environmental Chemistry.
S. E. Jorgensen, C. C. Hoffmann, and W. J. Mitsch.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 133-151, 7 fig, 8 tab, 12 ref.

Descriptors: *Meadows, *Marshes, *Denmark, *Limnology, *Nutrients, *Water pollution prevention, *Model studies, Wetlands, Reeds, Agricultural runoff, Water quality control, Filter crops, Swamps.

Nonpoint sources of nutrients are becoming more and more recognized as significant contributors to the eutrophication of lakes, fjords and bays. The use of wetlands as nutrient traps is one of the few available methods to reduce nonpoint nutrient discharges. Therefore, there has been an increasing interest in modeling the cycling of nutrients in wetlands with the following objectives: (1) to understands the function of these ecosystems in relation to their nutrients cycles; (2) to be able to quantify their nutrient removal capacity under var-

ious conditions; and (3) to examine whether it would be feasible to operate wetlands for optimum nutrient removal. Simulation modeling is suggested as a management tool for investigating the usefulness of wet meadows and other wetlands in Denmark for the protection of surface and groundwaters from nutrient inflows from agricultural lands. Field studies are currently measuring many physical, chemical, and biological aspects of a reed swamp adjacent to a lake and a wet meadow which is between a stream and agricultural upland. A modeling effort is being incorporated into these research projects to assist in the design of experimental measurements and to determine the efficiency of using wetland systems as buffer zones between agriculture and aquatic systems. (See also W89-10975) (Lantz-PTT)
W89-10982

SOME SIMULATION MODELS FOR WATER QUALITY MANAGEMENT OF SHALLOW LAKES AND RESERVOIRS AND A CONTRIBUTION TO ECOSYSTEM THEORY,
Ceskoslovenska Akademie Ved, Ceske Budejovice. Biomathematical Lab.
For primary bibliographic entry see Field 5G.
W89-10983

MODELLING EUTROPHICATION OF SHALLOW LAKES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Environmental Chemistry.
S. E. Jorgensen.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 177-188, 6 fig, 3 tab, 14 ref.

Descriptors: *Shallow water, *Limnology, *Eutrophication, *Lakes, *Model studies, Ecosystems, Phytoplankton, Nutrients, Case studies, Water quality management, Zooplankton, Performance evaluation, Correlation coefficient, Eutrophic lakes.

Many shallow lakes suffer from eutrophication due to high inputs of nutrients relative to the water volume. It is therefore not astonishing that many eutrophication models have been developed for shallow lakes. This chapter attempts to present the state of the art in modeling the eutrophication process for shallow lakes, by offering a summary of what has been learned from experience in the field during the last 12 years. A case study model of Lake Glumso, Denmark, concludes that it is feasible to develop and construct eutrophication models and use them as management tools to make predictions. This does not imply that the model cannot be improved considerably. The model which has been used assumes a certain ecological structure and certain species of phytoplankton and zooplankton. It was observed, however, that a considerable shift in the phytoplankton species composition took place. Furthermore, it is also desirable to improve the prognosis. A correlation coefficient for a comparison of observed and predicted values was 0.66; it would probably be desirable to get a correlation coefficient of 0.85 or more. (See also W89-10975) (Lantz-PTT)
W89-10984

SYSTEMS ECOLOGY OF OKEFENOKEE SWAMP,
Georgia Univ., Athens. Dept. of Zoology.
B. C. Patten.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 189-215, 11 fig, 31 ref.

Descriptors: *Systems analysis, *Limnology, *Ecosystems, *Okefenokee Swamp, *Swamps, Wetlands, Mathematical models, Theoretical analysis, Ecology.

A vast inaccessible wetland wilderness, Okefenokee Swamp is being studied as a hierarchical, dynamical system. Formal system theory, which underlies empirical research and modeling at different levels of organization, makes possible lawful, in addition to empirical, development of findings. The purpose of the study is to understand Okefenokee as an organized whole, and in the process to generate some new avenues of ecology from the systems approach. There are several elements to the approach: (1) an overall plan which has identified ultimate goals and the steps to reach them; (2) a basis in mathematical system theory for all theoretical and empirical work; (3) a modeling plan consistent with this basis; and (4) empirical research, initially loosely guided by the basis and models, but having a tightening relationship to them as the program matures. Only a cursory description of these elements is provided, with a few examples; the theoretical rather than empirical side is emphasized as this is what is most different among ecosystem studies. (See also W89-10975) (Lantz-PTT)
W89-10985

COMPREHENSIVE COOLING WATER STUDY. FINAL REPORT: VOLUME IV, WETLANDS.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5C.
W89-11002

COMPREHENSIVE COOLING WATER STUDY. FINAL REPORT: VOLUME VII, ECOLOGY OF PAR POND.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5C.
W89-11003

PHYTOPLANKTON DYNAMICS OF THE FRESH, TIDAL POTOMAC RIVER, MARYLAND, FOR THE SUMMERS OF 1979 TO 1981: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
R. R. H. Cohen.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2234-C, 1988. p34, 23 fig, 12 tab, 78ref.

Descriptors: *Population dynamics, *Phytoplankton, *Tidal rivers, *Potomac River, Maryland, Water quality, Estuaries, Nutrients, Primary productivity, Ecosystems, Chlorophyll a, Clams, Phosphorus.

The distribution and abundance of phytoplankton in the fresh, tidal Potomac River, MD, was different during 1979-81 from that observed in the 1960's and 1970's. Concentrations of phytoplankton in the 1960's and 1970's reached maximum attainable levels that were limited only by self-shading. A sag in phytoplankton abundance, apparent during the summers of 1980 and 1981 between Rosier Bluff and Marshall Hall, appears to have been caused by the Asiatic clam, Corbicula fluminea. Reduced abundance of phytoplankton throughout the entire fresh, tidal river during the summers of 1980 and 1981 may have been due to grazing by Corbicula, high discharge, and perhaps phosphorus limitation in late August at and of Hallowing Point. Phytoplankton growth rates and chlorophyll-to-cell ratios were highest at Hatton Point and Marshall Hall (the sag reach). A model was constructed that predicted phytoplankton growth rates by varying only chlorophyll a concentration and light penetration. Nutrient concentrations were not required to make the model fit the data. Primary productivity was highest for the year during August 1980 and August 1981. Productivity/unit chlorophyll was highest at Hatton Point, where reduced concentrations of phytoplankton permitted the deepest light penetration in the fresh, tidal river. (See also W89-11069) (Author's Abstract)
W89-11068

2I. Water In Plants

ALLELOPATHY IN SALINE AGRICULTURAL LAND: VEGETATION SUCCESSIONAL CHANGES AND PATCH DYNAMICS,
Nuclear Inst. for Agriculture and Biology, Faisalabad (Pakistan).
K. Mahmood, K. A. Malik, K. H. Sheikh, and M. A. K. Lodhi.
Journal of Chemical Ecology, Vol. 15, No. 2, p 565-579, February 1989. 2 fig, 7 tab, 32 ref.

Descriptors: *Land reclamation, *Ecological distribution, *Soil contamination, *Cultivated lands, *Vegetation establishment, *Saline soils, *Plant populations, *Succession, *Salt tolerance, *Halophytes, *Grasses, *Land reclamation, Ecology, Weeds, Nutrients, Pakistan.

The addition of toxic substances to the environment by other plants allelopathy can play a major role in plant growth. In reclamation fields of salt-affected wasteland in Pakistan, five plant communities colonized the undisturbed land, represented by Cynodon dactylon, Desmostachya bipinnata, Prosopis juliflora, Sporobolus arabicus, and Suaeda fruiticosa. Kallar grass (Leptochloa fusca), a highly salt tolerant plant when cultivated, shared dominance with Cynodon, Desmostachya, and Sporobolus in 15-month-old kallar grass fields. Through successional stages, soil pH, salinity, sodicity, and Na, K, Ca + Mg significantly decreased due to leaching. Electrical conductivity successively changed form 13.0 to 3.0 to 1.0, while soil total nitrogen, NH4 nitrogen, NO3 nitrogen and available P significantly increased. In high-density kallar grass fields, six weed species appeared only in well-defined patches and radially eliminated or reduced kallar grass growth. Many soil factors, such as pH, EC, NH4 nitrogen, NO3 nitrogen and available P analyzed in patch vegetations oils, were mostly either comparable or significantly better than those of surrounding kallar grass fields. On the other hand, aqueous extracts of all six invading species and Kallar grass significantly reduced kallar grass seed germination to varying degrees. Further, decaying leaf powder of allelopathically suspected species significantly reduced kallar grass biomass, which varied from species to species and in most cases corresponded with field data of Kallar grass in patch vegetation. Allelopathic behavior in patch dynamics was in areas where soil saline-sodic conditions had improved greatly (e.g., EC = from 13.0 to only 1.0) due to kallar grass plantation. Further, Suaeda appeared to be a poor competitor when soil conditions improved for other species as well. Allelopathy may be a factor in determining growth and distribution of plants in saline or sodic soils. (Author's abstract)
W89-10572

LIGHT RESPONSES OF A SUBMERSED MACROPHYTE: IMPLICATIONS FOR SURVIVAL IN TURBID TIDAL WATERS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. J. Goldsborough, and W. M. Kemp.
Ecology ECOLAR, Vol. 69, No. 6, p 1775-1786, December 1988. 5 fig, 4 tab, 58 ref. EPA Grants R805932010 and X003248010.

Descriptors: *Photosynthesis, *Irradiation, *Estuarine environment, *Turbidity, *Macrophytes, Plant growth, Plant morphology, Leaves, Biomass, Ecosystems, Tidewater, Chlorophyll a, Acclimatization, Sea grasses, Pigments, Light intensity, Chesapeake Bay.

Responses and acclimation of the submersed vascular plant Potamogeton perfoliatus to changes in total irradiance were investigated by growing replicate plant populations under neutral density screens to create three treatment levels (11, 32, and 100% of ambient). Changes in the relationship between photosynthesis and irradiance (P-I) were monitored during a 17-day treatment period and a 16-day 'recovery' period, as were concentrations of photosynthetic pigments and several morphological features. Both initial slope of P-I relations and leaf chlorophyll a content increased significantly within three days after the beginning of shade treatment. These responses, which represent mechanisms of increasing photosynthetic efficiency at low irradiance, were also reversed within three days after treatment removal. Significant morphological responses to and recovery from shade were evident within 10 days, including: elon-

gation of stems, thinning of lower leaves, and canopy formation at the water surface. Preliminary calculations indicate that both photosynthetic and morphological acclimations to shade conferred substantial improvements in P. perfoliatus production at experimentally reduced irradiance compared to pretreatment conditions. Significant decreases in plant stem density, biomass, and reproduction, as well as increases in mortality, were observed for plants at low (but not medium) growth irradiance. The inability of populations treated at low irradiance to exhibit any recovery (i.e., post-treatment increases) in these variables after 16 days of full ambient light suggests that 11% of ambient irradiance was below the minimum level needed for survival of this plant. Time scales for significant shade acclimation responses were comparable to the temporal scales of changes in light climate for aquatic ecosystems such as Chesapeake Bay. It is argued that although stem elongation is a beneficial response to shade for P. perfoliatus in turbid lakes, it may be nonadaptive in turbulent tidal waters because of increased susceptibility to fragmentation. (Author's abstract)
W89-10651

DEGRADATION OF MANGROVE LEAVES IMMERSED IN THE ESTUARY OF NAKAMA RIVER, OKINAWA,
Kochi Univ. (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2L.
W89-10660

2J. Erosion and Sedimentation

SPATIAL VARIATIONS IN THE SULFUR CHEMISTRY OF SALT MARSH SEDIMENTS AT NORTH INLET, SOUTH CAROLINA,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
L. R. Gardner, T. G. Wolaver, and M. Mitchell.
Journal of Marine Research JMMRAO, Vol. 46, No. 4, p 815-836, November 1988. 6 fig, 2 tab, 46 ref.

Descriptors: *Salt marshes, *Sulfur compounds, *Sediments, *South Carolina, Marsh sediments, Spartina, Crabs, Spatial.

Profiles of particulate and dissolved sulfur species were measured in marsh sediments along three transects across the various growth zones (tall, medium, and short) of Spartina alterniflora. In general, organic carbon, total sulfur, pyritic sulfur, pyritization index and dissolved sulfide increased with distance from tidal creek banks, whereas acid volatile sulfur (FeS), pH and Eh decreased with distance. These patterns probably are controlled by spatial variations in belowground production, pore water movement and fiddler crab burrowing. The creekside marsh (tall Spartina) is characterized by lower rates of belowground production (and lower rates of sulfate reduction and sulfide reduction production), more vigorous drainage of pore water and more intense fiddler crab burrowing as compared to the high marsh (short Spartina). Lower dissolved sulfide concentrations in the creekside marsh are promoted by lower rates of sulfate reduction and removal of dissolved sulfide by drainage at low tide. Higher pH in the creekside marsh is fostered by removal of reduced sulfur (dissolved sulfide by drainage and pyrite by fiddler crab burrowing) which then cannot be oxidized in the sediment to yield acid. The higher pH and lower dissolved sulfide of the creekside marsh, in turn, slow rate of conversion of iron oxide into pyrite in accordance with Rickard's rate laws and foster a lower pyritization index. The lower pyritization index of the creekside marsh also is promoted by fiddler crab burrowing which removes pyrite from the sediment and replaces it with fresh iron oxide from the surface or suspended source. Finally, the greater availability of reactive iron oxide in the creekside marsh may shift the relative rates of FeS and FeS2 formation such that a higher steady state concentration of FeS can be maintained there as compared to the high marsh. (Author's abstract)
W89-10565

INTERPRETATION OF TRANSIENT PORE PRESSURES IN SALT MARSH SEDIMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2L.
W89-10645

SEDIMENT-WATER EXCHANGE OF DISSOLVED NUTRIENTS AT AN INTERTIDAL SITE IN THE UPPER REACHES OF THE BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
For primary bibliographic entry see Field 2L.
W89-10668

SEDIMENT ACCUMULATION AT A FRINGE MARSH DURING TRANSGRESSION, OYSTER, VIRGINIA,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W89-10670

RIVER PLANFORM FACIES MODELS: THE SEDIMENTOLOGY OF BRAIDED, WANDERING AND MEANDERING REACHES OF THE SQUAMISH RIVER, BRITISH COLUMBIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
G. J. Brierley.
Sedimentary Geology SEGEBX, Vol. 61, Nos. 1 & 2, p 17-35, January 1989. 4 fig, 7 tab, 84 ref. NSERC Grant A8376.

Descriptors: *Model studies, *Sedimentology, *River mechanics, *Fluvial sediments, *Sedimentary structures, *Braided streams, *Meanders, *Alluvial channels, *British Columbia, Structural models, Gravel, Statistical methods, Sedimentation, Canada.

The Squamish River, in common with other large, high-energy, gravel-bed rivers in the Coast Mountain Ranges of British Columbia, exhibits a distinct downstream sequence of planform types. Using consistent field and analytical techniques, river planform facies models were dervied for each of three contiguous reaches of the Squamish: braided, wandering and meandering. Sediment zones less than thirty years old were sampled systematically upon bars in each reach by digging holes to channel gravel depth or the water table. Sediment sequences were classified using a facies coding scheme based upon particle size, bedding properties and structural characteristics. the internal organization of facies types varies considerably in the facies models derived for each planform reach using Markov analysis. These planform facies models are shown to be unrepresentative of local sediment organization, as many one-and two-step upward facies transitions predicted for a given planform type are found with greater abundance in one or both of the other models. Predicted transitions can be viewed as statistical artifacts and are not representative of sediment associations observed in the field. Examination of the internal organization of small-scale structural units using summary statistical data indicates no consistent variation with channel planform. It is concluded that differentiation of fluvial depositional suites using one-dimensional data at the scale of channel planform is inapplicable. (Author's abstract)
W89-10674

RATES AND PROCESSES OF CHANNEL DEVELOPMENT AND RECOVERY FOLLOWING THE 1980 ERUPTION OF MOUNT ST. HELENS, WASHINGTON,
Cascades Volcano Observatory, Vancouver, WA.
D. F. Meyer, and H. A. Martinson.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 115-127, April 1989. 5 fig, 1 tab, 12 ref.

Descriptors: *Channel morphology, *Volcanoes, *Geomorphology, *Washington, *Stream erosion, *Sedimentation, *Aggradation, *Mount St Helens, Sediment discharge, Lahars, North Fork Toutle River, Avalanches, Slope degradation, Seasonal variation, Channel accretion, Incised rivers.

Stream channel development in response to the eruption of Mount St. Helens on 18 May 1980 resulted in some of the largest sediment yields documented anywhere on earth. Development of new channels on the 2.7-cu km debris-avalanche deposit in the North Fork Toutle River caused net erosion of as much as 130,000 t/sq km annually. Development of these channels followed a four-stage sequence of channel initiation, channel incision (with relatively constant width-to-depth ratio), channel widening accompanied by aggradation, and channel widening accompanied by scour-and-fill with little change in average channel elevation. These channels remain stable both in width and elevation. Lahars affected channel and valley morphology on all flanks of the volcano. Steep, upstream reaches generally incised and widened during the first year following the eruption and aggraded during the following three years. Gently sloping downstream reaches aggraded and widened during the first year and incised during the following three years. The most rapid adjustments occurred during the first two winters following the eruption. The principal effect of the blast on channels throughout the 550 sq km devastated area was the subsequent rapid delivery of sand--and silt-size sediment eroded from hill slopes. Channels aggraded during early storms of the 1980-81 winter, but incised during later storms the same winter. Subsequent channel enlargement was constrained by logs deposited in channels by the blast and by post-1980 shallow debris slides. Since 1984, instability and sedimentation in lahar--and blast-affected channels have been within the range of pre-1980 levels. (Author's abstract)
W89-10758

SEDIMENT ACCUMULATION AND ITS EFFECTS ON A MISSISSIPPI RIVER OXBOW LAKE,
Agricultural Research Service, Oxford, MS.
C. M. Cooper, and J. R. McHenry.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 33-37, January/February 1989. 6 fig, 2 tab, 9 ref.

Descriptors: *Sedimentation rates, *Mississippi River, *Oxbow lakes, *Agriculture, Lakes, Soybeans, Rice, Cotton, Cultivated lands, Flow, Overland flow, Lake morphology, Mississippi.

Recent sediment accumulation rates were measured in Moon Lake, a large (10.1 sq km) Mississippi River oxbow lake in northwestern Mississippi. Moon Lake, which receives channeled inflow from an intensively cultivated soybean, rice, and cotton watershed (166 sq km) and limited overland flow from surrounding lands, exhibited depositional patterns that were associated with (1) points of inflow, (2) flow patterns, and (3) lake morphology. From 1954 to 1965, 70% of the lake bottom experienced accumulation rates greater than 2 cm/yr. Accumulation rates exceeded 4 cm/yr in areas of delta formation. Changes in cropping systems during the 1960s, from cotton to soybeans and rice which require less cultivation, resulted in significantly (alpha = 0.01) less sediment accumulation during the period 1965-1982 when 86% of the lake averaged less than 2 cm/yr sediment deposition. If current sediment accumulation rates continue, open water habitat in the lake will be reduced by only 3 to 7% during the next 50 years. (Author's abstract)
W89-10841

HEAVY METAL CONTENT IN THE STREAM SEDIMENTS ADJACENT TO A SANITARY LANDFILL,
Southwest Missouri State Univ., Springfield.
For primary bibliographic entry see Field 5B.
W89-10843

GEOMORPHOLOGY AND HYDROLOGY OF KARST TERRAINS,
W. B. White.
Oxford University Press, New York. 1988. 464 p.

Descriptors: *Karst hydrology, *Geomorphology, *Karst, *Geohydrology, *Surface-groundwater re-

lations, Hydrologic properties, Fluid dynamics, Groundwater movement, Geochemistry, Aquifers, Carbonate rocks, Drainage systems, Chemistry, Porous media, Water supply, Crystalline rocks, Land use, Water resources development.

The geomorphology of karst landscapes and the hydrology of karst drainage systems are now subjects of interest to water supply specialists, urban planners, and environmental engineers. One of the primary objectives of this book is to address karst hydrology and geomorphology from this new point of view. The first four chapters are mainly descriptive, painting a picture of surface and underground landforms in karst regions. Chapter 5 provides a summary of carbonate geochemistry as the subject is understood at present. Chapter 6 does the same for karst hydrology. It begins with groundwater in ordinary porous media aquifers, introduces some principles of fluid mechanics, and then outlines some of the current ideas on the hydrology of carbonate rocks. Chapters 7,8,9, and 10 are the heart of the subject. These chapters discuss the chemistry of karst waters, the processes of sedimentary in-filling, the origin of caves, and the evolution of karst systems down through geologic time. The material in these chapters is drawn mainly from contemporary research. Karst is not limited to carbonate rocks. Chapters 11 and 12 briefly introduce karst in evaporite rocks, which are more soluble than the carbonates, and karst in such rocks as granites and quartzites, which are generally regarded as insoluble. The last two chapters are devoted to environmental problems in karst, loosely separated into land-use problems (Chapter 13) and water resources problems (Chapter 14). In reality, the two problems cannot be separated. (Lantz-PTT)
W89-10964

COMPUTER SIMULATION OF SUSPENDED SOLID DISPERSION IN GRAVITY CURRENT,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
K. Mizumura.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 385-392, 4 fig, 7 ref.

Descriptors: *Gravity flow, *Computer models, *Simulation, *Density currents, *Suspended solids, *Turbidity flow, *Model studies, Hydraulic properties, Vertical flow, Fluid mechanics, Suspended load, Mathematical equations, Density stratification, Monte Carlo method, Hydrodynamics, Lakes, Reservoirs, Suspended sediments, Hydraulic engineering, Meteorology.

In hydraulic engineering, gravity current is found when turbidity flow intrudes into seas, lakes, or reservoirs. It is also formed as the front of cold air or the dust storm on desert in meteorology. The phenomenon is caused by the density difference between two fluids. The interest in this phenomenon lies in the distribution of the velocity and the density. In this study, the two dimensional gravity current is considered. The vertical velocity distribution is given by the equation of the wall jet and the vertical density distribution is simulated by the Monte Carlo method. The motion of solid particles in it is simulated by the Monte Carlo method. The result was in good agreement with the observed data. (See also W89-11033) (Author's abstract)
W89-11061

LOADS OF SUSPENDED SEDIMENT AND NUTRIENTS FROM LOCAL NONPOINT SOURCES TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W89-11069

2K. Chemical Processes

EFFECT OF SALINITY ON THE MICROBIAL MINERALIZATION OF TWO POLYACRYLIC AROMATIC HYDROCARBONS IN ESTUARINE SEDIMENTS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 5B.
W89-10550

PREDICTION OF THE SOLUBILITY OF HYDROCARBONS IN WATER USING UNIFAC,
Kuwait Univ., Safat. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-10590

HYDROGEOCHEMISTRY OF FRESHWATERS CROSSED BY THE TRANSAMAZON HIGHWAY, NORTHERN BRAZIL (HYDROGEOCHEMIE VON FLEISSGEWASSERN IM BEREICH DER TRANSAMAZONICA (NORDBRASILIEN),
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch.
Amazoniana, Vol. 9, No. 3, p 371-409, December 1985. 16 fig, 7 tab, 58 ref. English summary.

Descriptors: *Water chemistry, *Amazon, *Rivers, *Brazil, *Geochemistry, Hydrogen ion concentration, Conductance, Suspended solids, Color, Alkalinity, Anions, Cations, Organic carbon, Trace metals, Hardness, Silicates, Tropical regions, Chemical composition.

In the context of a comprehensive study of the hydrogeochemistry and classification of Amazon freshwaters, 80 rivers crossing the Transamazon highway between Altamira and Humaita (Brazil) were analyzed (pH, specific conductance, suspended solids, color, alkalinity, Cl, SO4, Na, K, Mg, Ca, Ba, Sr, Al, Fe, Mn, Cu, Si, organic C, NH4, and PO4). Compared with the world average, most waters have low to extremely low levels of major cations (Na, K, Mg, Ca), major anions (HCO3, Cl, SO4) and trace metals (Ba, Sr, Al, Cu). The levels of Si and Fe are similar to the world average while Mn and H are above the world average. The waters are chemically very heterogeneous as shown by large differences between minimum and maximum values for a number of chemical parameters. The range of parameters which govern alkalinity and hardness (Ca, Mg, HCO3 and H) are particularly wide. The ordination of waters with respect to the frequency of observed concentrations of a gven element usually shows a non-normal distribution pattern. For levels of Ca, HCO3, Mg, Na, Sr, SO4, Sr, Ba, MN and Fe most waters fall in the lowest tenth of the total concentration range. Ordination of the waters with respect to major ion dominance results in the recognition of 26 ionic combinations. Comparison of waters with identical ionic sequences showed that a chemically uniform water type is not represented, since differences in the percentages of various ions are too great. Ionic diagrams of waters crossing the Transamazon highway transect shows that the ion-richest waters have clear Ca and HCO3 dominance (carbonate waters). The ion-poorest waters are of an alkali chloride nature. However, the majority are carbonate waters lacking well-expressed dominance of a single major cation. The presence of HCO3 may be largely explained by the chemical weathering of silicate minerals. Waters flowing from geologically uniform watersheds were grouped and their ionic diagrams and ionic strength compared. (Author's abstract)
W89-10598

RADON CONCENTRATION IN GROUND WATERS IN SOME AREAS OF GRANITE INTRUSION IN VARIOUS AGES,
Saga Univ. (Japan). Faculty of Science and Engineering.
K. Isagai, and K. Isagai.
Japanese Journal of Limnology RIZAAU, Vol. 49, No. 4, p 269-278, October 1988. 6 fig, 2 tab, 20 ref.

Descriptors: *Radioactivity, *Water pollution sources, *Groundwater, *Radon, *Radium, Weathering, Japan, Granites.

It has been reported that the later the intrusion age of granite, the higher is its radium content. It may be supposed that groundwater with high radon concentration is found in the area of granite with high radium content. Therefore, the radon concentrations of groundwaters in areas of granite with various intrusion ages were measured. No relationship between radium content and intrusion age of granite was observed. The following observations were made: groundwaters with high radon concentration exist in the area of very old granite, and those with low radon concentration exist in the area of young granite. Areas where radon concentration in groundwater are high are distributed on or near the area where fault lines and/or intrusive rock masses exist. In general, no relationship between the radon concentration in groundwaters and the alkalinity or electric conductivity was observed, and it was independent of chemical weathering. (Author's abstract)
W89-10607

CALCIUM AND MAGNESIUM IN DAL LAKE, A HIGH ALTITUDE MARL LAKE IN KASHMIR HIMALAYAS,
Kashmir Univ., Srinagar (India). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-10619

HIGH CALCIUM CONCENTRATION IN WATER INCREASES MORTALITY OF SALMON AND TROUT EGGS,
Fish and Wildlife Service, Cortland, NY.
For primary bibliographic entry see Field 8I.
W89-10625

DYNAMICS OF PARTIAL ANAEROBIOSIS, DENITRIFICATION, AND WATER IN A SOIL AGGREGATE: SIMULATION,
Agricultural Univ., Wageningen (Netherlands). Dept. of Theoretical Production Ecology.
For primary bibliographic entry see Field 2G.
W89-10646

NATURAL TRACE METAL CONCENTRATIONS IN ESTUARINE AND COASTAL MARINE SEDIMENTS OF THE SOUTHEASTERN UNITED STATES,
Skidaway Inst. of Oceanography, Savannah, GA.
H. L. Windom, S. J. Schropp, F. D. Calder, J. D. Ryan, and R. G. Smith.
Environmental Science and Technology ESTHAG, Vol. 23, No. 3, p 314-320, March 1989. 4 fig, 1 tab, 18 ref. U.S. DOE Grant DE-FG09-86ER60435.

Descriptors: *Trace metals, *Estuaries, *Marine sediments, *Aluminum, *Detritus, Inorganic compounds, Sediment-water interfaces, Organic matter, Arsenic, Cobalt, Chromium, Copper, Iron, Lead, Manganese, Nickel, Zinc, Cadmium, Mercury, Silicates, Comparison studies, Coastal zone management, Bays.

Many substances that occur naturally, such as trace metals and nutrients, may be mobilized as a result of natural processes as well as by man's activities and thus may become enriched in coastal and estuarine sediments. The concentrations of trace metals in natural estuarine and coastal marine sediments are predominantly determined by inorganic detrital, rather than organic and nondetrital materials. Over 450 sediment samples from estuarine and coastal marine areas of the southeastern United States remote from contaminant sources were analyzed for trace metals. Although these sediments are compositionally diverse, As, Co, Cr, Cu, Fe, Pb, Mn, Ni, and Zn concentrations covary significantly with aluminum, suggesting that natural aluminosilicate minerals are the dominant natural metal-bearing phases. Cd and Hg do not covary with aluminum apparently due to the importance of the contribution of natural organic phases to their concentration in sediments. It is suggested

that the covariance of metals with aluminum provides a useful basis for identification and comparison of anthropogenic inputs to southeastern U.S. coastal/estuarine sediments. By use of this approach sediments from the Savannah River, Biscayne Bay, and Pensacola Bay are compared. (Author's abstract)
W89-10655

ACIDIC DEPOSITION AND CISTERN DRINKING WATER SUPPLIES,
Olem Associates, Washington, DC.
For primary bibliographic entry see Field 5B.
W89-10656

ALUMINIUM AND ACID RAIN: MITIGATING EFFECTS OF NACL ON ALUMINIUM TOXICITY TO BROWN TROUT (SALMO TRUTTA FARIO) IN ACID WATER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Toxicology.
For primary bibliographic entry see Field 5C.
W89-10667

PARTICULATE ORGANIC SULFUR IN THE WATERS OF THE SOUTHERN CALIFORNIA BIGHT,
Scripps Institution of Oceanography, La Jolla, CA. Inst. of Marine Resources.
For primary bibliographic entry see Field 2L.
W89-10714

MEASUREMENTS AND INTERPRETATION OF DELTA-C13 OF METHANE FROM TERMITES, RICE PADDIES, AND WETLANDS IN KENYA,
National Center for Atmospheric Research, Boulder, CO.
S. C. Tyler, P. R. Zimmerman, C. Cumberbatch, J. P. Greenberg, and C. Westberg.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 341-355, December 1988. 2 fig, 5 tab, 40 ref. NASA order W-16,184.

Descriptors: *Methane, *Biochemistry, *Insects, *Rice, *Wetlands, Carbon dioxide, Isotopes, Organic carbon, Fungus, Air pollution, Kenya, Lakes, Rivers.

Ratios of C13/C12 have been measured in methane from a variety of sources in tropical Kenya. Ranges of delta-C13 in CH4 for termites (most values range from -56 to -64 o/oo, one is at -44 o/oo), one is at approximately-73 o/oo), rice paddies (range -57 to -63 o/oo), and wetlands (range-45 to -50 o/oo for Lake Baringo, approximately -55 o/oo in the Moloi River, approximately -62 o/oo and approximately -31 o/oo in two swamp areas) are presented. The data are interpreted with the help of additional measurements of delta-C13 of CO2 gas, and organic carbon in plant material, termite bodies, and termite fungus combs. The implications of these findings are related to the problem of studying the atmospheric methane budget. (Author's abstract)
W89-10717

ORIGIN AND MOVEMENT OF GROUNDWATER AND MAJOR IONS IN A THICK DEPOSIT OF CHAMPLAIN SEA CLAY NEAR MONTREAL,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2F.
W89-10749

PHOTOCATALYTIC OXIDATION OF NITRITE IN WATER TO NITRATE,
Institute of Fundamental Studies, Kandy (Sri Lanka).
K. Tennakone, S. Punchihewa, and R. U. Tantrigoda.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 299-305, 1989. 5 fig, 1 tab, 12 ref.

Descriptors: *Water treatment, *Water chemistry, *Chemical reactions, *Oxidation, *Solar radiation, *Organic matter, *Nitrates, Nitrites, Catalysts, Titanium oxide, Ultraviolet radiation, Drinking water, Water treatment.

It is known that organic matter and agrochemical contaminants in water can be completely mineralized by irradiation with sunlight in the presence of semiconductor catalysts, such as TiO2. By the same method, nitrite in water is converted to nitrate by irradiation in the presence of oxygen and titanium dioxide, which acts as a catalyst. In the present study, a 450-W mercury lamp was employed as a light source in a double-walled photochemical reactor. The rate of the reaction increased with increasing pH and it also depended on the amount of catalyst used. However, the percentage of UV light in sunlight is less than from a UV lamp, so that irradiation for a longer period of time would be necessary with a natural light source. Because nitrate is a less hazardous contaminant, this method might be worth investigating further for the treatment of drinking water. (Rochester-PTT)
W89-10755

URANIUM IN HOLOCENE VALLEY-FILL SEDIMENTS, AND URANIUM, RADON, AND HELIUM IN WATERS, LAKE TAHOE-CARSON RANGE AREA, NEVADA AND CALIFORNIA, U.S.A.,
Geological Survey, Denver, CO. Branch of Sedimentary Processes.
For primary bibliographic entry see Field 5B.
W89-10839

KINETICS OF ENVIRONMENTAL AQUATIC PHOTOCHEMISTRY: THEORY AND PRACTICE,
A. Leifer.
American Chemical Society Professional Reference Book, Washington, DC. 1988. 304p.

Descriptors: *Water chemistry, *Photoactivation, *Chemical reactions, *Kinetics, *Aquatic environment, Mathematical studies, Radiation, Light intensity, Solar radiation, Seasonal variation, Chemical properties, Mathematical equations, Solute, Experimental data.

Many chemicals present in aqueous media can undergo photochemical transformation in sunlight via direct or indirect photoreaction, at rates that depend on the solar irradiance, the chemical's molar absorptivity, and its reaction quantum yield. Direct photoreaction refers to those reactions in which a chemical absorbs sunlight and undergoes a chemical reaction. Indirect (or sensitized) photoreaction refers to those reactions in which another material absorbs sunlight and initiates a chemical reaction that transforms the chemical. Details of relevant aspects of the kinetics of environmental aquatic photochemistry are examined, so that the environmental scientist can determine relevant direct and indirect photoreaction rate constants and half-lives in sunlight, as a function of latitude and season of the year, anywhere in the northern hemisphere. Because the subject is highly mathematical, detailed derivations are given to enable the environmental scientist to grasp the concepts easily. Emphasis is placed on the theory of the kinetics of direct and indirect photoreaction in aqueous solution and on the fundamental principles of photoreaction that guide the selection of experimental approaches--particularly the photoreaction of chemicals at very low concentrations, conditions that normally prevail in aquatic media in the environment. Procedures for obtaining the requisite kinetic data are discussed in detail so that these experiments can be carried out easily and precisely. Procedures for the extrapolation of these data to a wide variety of environmental conditions are discussed. Comprehensive tables of solar irradiance are given, along with examples that illustrate the use of all the experimental data from these procedures. (Lantz-PTT)
W89-10940

SOLUBILITY OF DISPERSE DYES IN WATER: MEASUREMENT AND IMPLICATIONS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W89-11011

INTERACTIONS BETWEEN THORIUM AND HUMIC COMPOUNDS IN SURFACE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
For primary bibliographic entry see Field 5B.
W89-11015

2L. Estuaries

REGULATION OF PHYTOPLANKTON BIOMASS IN ESTUARINE ENCLOSURES,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
B. Riemann, T. G. Nielsen, S. J. Horsted, P. K. Bjornsen, and J. Pock-Steen.
Marine Ecology Progress Series MESEDT, Vol. 48, No. 3, p 205-215, October 3, 1988. 7 fig, 3 tab, 26 ref. Danish Environmental Protection Agency NPO 4.6 and Danish Natural Science Research Council J. no. 11-5573.

Descriptors: *Aquatic populations, *Mussels, *Marine environment, *Estuaries, *Phytoplankton, *Biomass, *Nutrients, Denmark, Fjords, Mytilus, Zooplankton, Predation.

Phytoplankton was followed in marine ecosystems in the Roskilde Fjord (Denmark) which was manipulated by the addition of benthic suspension feeder, planktivorous fish, nutrients and contact to with the sediment. During periods with high insolation and temperatures from 11 to 20 C, the manipulations caused marked changes in the development of phytoplankton biomass. Additions of Mytilus edulis reduced phytoplankton biomass to between 10 and 59% of controls, whereas addition of nutrients raised phytoplankton biomass to an average of 256% of controls. Generally, low growth rates of mussels were found in enclosures containing mussels alone. addition of planktivorous fish and nutrients increased growth rates of mussels. During June/July, when inorganic nitrogen limited phytoplankton growth, autotrophic picoplankton (1 to 2 microm cell diameter) constituted 70 to 93% of phytoplankton biovolume in enclosures containing mussels compared to 4 to 20% in controls. The mussels reduced phytoplankton biomass by only about 50% during this period, presumably due to low retention efficiency of the small cells. In April and September, however, when nitrogen did not control phytoplankton growth, picoplankton comprised < 0.001% of phytoplankton biovolume. During September (temperatures 11 to 13 C), M. edulis reduced chlorophyll levels to 10% of controls and the effects of nutrient additions were significantly reduced in enclosures containing mussels. The effect of fish addition revealed that zooplankton grazing removed about 20% of phytoplankton biomass. The sediment acted primarily as a nutrient source during summer. However, in April at temperatures > 6 C and in September, benthic suspension feeders maintained chlorophyll levels below those in enclosures with no sediment contact. The most important factors controlling phytoplankton biomass in the enclosures was the balance between nutrient input, phytoplankton size structure and the physiological state of the mussels. (Author's abstract)
W89-10534

REGULATION OF ZOOPLANKTON BY SUSPENSION-FEEDING BIVALVES AND FISH IN ESTUARINE ENCLOSURES,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
S. J. Horsted, T. G. Nielsen, B. Riemann, J. Pock-Steen, and P. K. Bjornsen.
Marine Ecology Progress Series MESEDT, Vol. 48, No. 3, p 217-224, October 3, 1988. 4 fig, 3 tab, 39 ref.

Descriptors: *Estuaries, *Zooplankton, *Nutrients, *Fish, *Mollusks, Filter feeders, Fjords, Denmark, Population dynamics, Mytilus, Predation.

Enclosure experiments were conducted during April, June/July and September in the eutrophic estuary Roskilde Fjord (Denmark), to reveal the effects of inorganic nutrients, suspension-feeding bivalves Mytilus edulis ad planktivorous fish (three-spined sticklebacks Gacterostereus aculeatus) on the zooplankton community > 45 microm. The addition of inorganic nutrients did not increase zooplankton biomass although it did increase the chlorophyll level, indicating that zooplankton production was not food limited. Filtration by M. edulis reduced the number of tintinnid ciliates and rotifers during all three experiments, but not the abundance of the larger zooplankton species. Additions of planktivorous fish reduced the densities of larger zooplankton species Acartia tonsa and Pleopis polyphemoides, but not of smaller species. An immense increase in numbers of A. tonsa and P. polyphemoides was observed in enclosures without fish, indicating that the larger crustacean zooplankton is strongly predator controlled. The qualitative and quantitative development of the zooplankton community in the enclosures was controlled in two ways: (1) from the top of the size spectrum by G. aculeatus, and (2) from the bottom of the size spectrum by M. edulis. (Author's abstract)
W89-10535

PHYTOPLANKTON RESPONSE TO INTERMITTENT STIRRING AND NUTRIENT ADDITION IN MARINE MICROCOSMS,
Instituto de Ciencias del Mar, Barcelona (Spain).
M. Estrada, C. Marrase, and M. Alcaraz.
Marine Ecology Progress Series MESEDT, Vol. 48, No. 3, p 225-234, October 3, 1988. 8 fig, 3 tab, 35 ref. Comision Asesora de Investigacion Cientifica y Tecnica grant no. 3246/79.

Descriptors: *Marine environment, *Ecosystems, *Phytoplankton, *Nutrients, Mixing, Diatoms, Aquatic productivity, Nitrates, Phosphates, Silica, Growth chambers.

The interactions between mixing and nutrient input in aquatic ecosystems were studied. The response of a marine phytoplankton population enclosed in 30 cu dm cylindrical microcosms was subjected (in duplicate) to the following treatments: (1) short periods (15 min) of strong mixing every 2 to 3 d, (2) addition of nutrients every 2 to 3 d, (3) simultaneous mixing and addition of nutrients at the same intervals, and (4) absence of mixing and nutrient additions. Eight thirty liter culture vessels were filled with sea water from the Masnou Nautical Harbour (Barcelona, Spain) and subjected to different conditions of stirring and nutrient additions. The contents of four of the vessels were stirred vigorously for 15 min every 2 to 3 d. Two of the stirred and two of the non-stirred vessels received nitrate, phosphate and silicate nutrient additions at the same time intervals. After an initial bloom dominated by centric diatoms, the sequence of phytoplankton assemblages dominating in different phases of the experiments varied according to treatments. In enriched tubes, total numbers of cells and diatoms were much higher than in non-enriched tubes, and the initial bloom involved higher concentrations of large diatoms. Mixing altered the abundance of several species, but its most apparent effect was proliferation and maintenance, in the vessels that also received nutrient addition, of the large-celled diatom Bellerochea yucatanensis. (Miller-PTT)
W89-10536

INFLUENCES OF RIVER FLOW ON THE DYNAMICS OF PHYTOPLANKTON PRODUCTION IN A PARTIALLY STRATIFIED ESTUARY,
Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
T. C. Malone, L. H. Crocker, S. E. Pike, and B. W. Wendler.
Marine Ecology Progress Series MESEDT, Vol. 48, No. 3, p 235-249, October 3, 1988. 12 fig, 5 tab, 44 ref.

Descriptors: *Estuaries, *River flow, *Phytoplankton, *Cycling nutrients, *Biomass, *Stratification, *Seasonal variation, *Nitrogen cycle, Chesapeake Bay, Nutrients, Productivity, Saline-freshwater interfaces.

The relationship was studied between seasonal variations in phytoplankton biomass and productivity in the mesohaline reach of the Chesapeake Bay and the riverine input of nitrogen recycling within the bay. The mesohaline reach of the bay receives most of its allochthonous nutrient input from a single source, the Susquehanna River. Seaward of the turbidity maximum, concentrations of dissolved inorganic nutrients decrease rapidly as phytoplankton biomass increases along the salinity gradient. The annual cycle of riverine nutrient input is in phase with phytoplankton biomass but out of phase with phytoplankton productivity in this region. Riverine nutrient input and phytoplankton biomass peak during spring, but phytoplankton productivity peaks during the summer. Seasonal variations in biomass are correlated with light and temperature. Evidence is presented which suggests that the spring flux of nitrogen from the watershed and the summer productivity maximum are coupled via the accumulation and sedimentation of phytoplankton biomass during spring and subsequent recycling of regenerated nitrogen into the euphotic zone during the summer. It is concluded that the occurrence of maximum productivity during summer in the mesohaline reach of the bay is a consequence of the recycling of nitrogen delivered to the system during the previous spring. Inter-annual variations in the magnitude of the summer productivity maximum appear to be related to variations in vertical stratification which influences the vertical flux of regenerated ammonium from the benthos to the euphotic zone. In this context, the extent of seasonal oxygen depletion during summer appears to be determined by riverine nitrate input during the spring freshet and the strength and variability of vertical stratification during summer. (Author's abstract)
W89-10537

BLY CREEK ECOSYSTEM STUDY--NITROGEN EXCHANGE WITHIN A EUHALINE SALT MARSH BASIN OF NORTH INLET, SOUTH CAROLINA,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. G. Wolaver, G. J. Whiting, R. F. Dame, T. M. Williams, and J. D. Spurrier.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 107-116, November 10, 1988. 5 fig, 2 tab, 34 ref. NSF grant DEB 8119752.

Descriptors: *South Carolina, *Ecosystems, *Salt marshes, *Tidal marshes, *Estuaries, *Nitrogen cycle, Cycling nutrients, Wetlands, Tidal effects.

Nitrogen exchange within the Bly Creek basin (North Inlet, South Carolina) was studied during 34 tidal cycles between 20 June 1983 and 19 Jun 1984. Estimates of tidally mediated transport were made along with annual estimates of nitrogen input to the basin via streamwater, groundwater, and rainwater. Within the basin, effects of the vegetated marsh, oyster reef community, and the tidal creek on material transport were assessed. There was a small, but statistically insignificant, NH4(+) export from the basin through the tidal creek of 433 kg N/yr; inputs into the basin via streamwater, groundwater, and rain totalled 78 kg NH4(+)-N/yr. The NH4(+) mass balance suggests the basin is not a source or a sink for this constituent to the surrounding estuary. However, since the vegetated marsh surface imports about 1500 kg NH4(+)-N/yr, the tidal creek subsystem must act as a source. It is suggested that remobilization of NH4(+) within the tidal creek water column and/or benthic community produces the ammonium necessary to satisfy the input of this constituent to the vegetated marsh. There was also a small insignificant import of nitrate + nitrite into the basin through the tidal creek of 158 kg N/yr. The vegetated marsh is capable of removing all the nitrate + nitrite potentially imported into this system via tidal water, streamwater, groundwater, and rain. There was a significant dissolved organic nitrogen (DON) export from the basin of 7782 kg N/yr or 11.7 g N/sq m/yr, whereas there was a statistically insignificant import of particulate nitrogen (PN). The vegetated marsh within the basin appears to be the main source of DON material to the basin as a significant amount of DON was exported both during tidal inundation and via runoff during tidal exposure. Due to the lack of statistical significance in the tidally mediated PN flux, it is difficult to state whether the basin is a source or sink. However, a negative association between tidally mediated PN flux and maximum tidal height suggests that the marsh surface is important in removing PN during high tide conditions. (Author's abstract)
W89-10539

STANDING STOCK AND PRODUCTION OF THE CHANG JIANG (YANGTSE RIVER) AND THE ADJACENT EAST CHINA SEA,
National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography.
X. Ning, D. Vaulot, Z. Liu, and Z. Liu.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 141-150, November 10, 1988. 8 fig, 1 tab, 46 ref.

Descriptors: *China, *Chang jiang River, *Estuaries, *Phytoplankton, *Chlorophyll, *Primary productivity, Cell density, Water currents, Particulate matter, Diatoms, Light penetration.

Cell density and dominant species of eukaryotic phytoplankton, chlorophyll concentration and primary production was determined in the Chang jiang estuary and dilution zone in January and July 1986. Although the investigated area is subject to a variety of influences from the Chang Jiang, the Taiwan Current, and the Yellow Sea Current that results in very complicated spatial patterns that classical oceanographic ship observations can only imperfectly resolve, a clear zonation of phytoplankton was revealed in summer. In winter, phytoplankton was dominated by small cells (< 10 microm), closely associated to particulate matter. In summer, the most striking feature of chlorophyll and primary production distributions was the presence of sharp maxima localized about 100 km offshore at salinities between 25 and 30% and related to diatom populations. The critical factor responsible for these maxima was the increased light availability following sedimentation of the particulate matter originating from the river, as observed in front of other major world rivers such as the Zaire and the Amazon. This photosynthetic activity resulted in high oxygen concentrations and phosphate depletion in the surface layer. In both seasons, in situ areal productivity and light availability were related by a simple empirical relationship similar to that established for other medium-sized estuaries. The established validity of this relationship could considerably simplify future biological oceanography studies in this zone since photosynthetic production could be computed from surface irradiance, concentrations of chlorophyll, and suspended matter obtained either from shipboard measurements or remote sensing. (Miller-PTT)
W89-10540

MICROBIOMASS STRUCTURE AND RESPIRATORY ACTIVITY OF MICRONEUSTON AND MICROPLANKTON IN THE NORTHWESTERN MEDITERRANEAN SEA INFLUENCED BY RHONE RIVER WATER,
Centre d'Oceanologie de Marseille (France).
T. Mimura, J. Romano, and Y. Souza-Lima.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 151-162, November 10, 1988. 1 fig, 7 tab, 69 ref. Conselho Nacional de Desenvolvimento Ceintifico e Technologica Brasil grant 20 0605/83 OC and French Government grant 832049 STD 2.

Descriptors: *Biomass, *Plankton, *Respiration, *Mediterranean Sea, Rhone River, Neuston, Dynamics, Organic carbon, Biochemical oxygen demand, Chlorophyll, Muramic acid, Adenosine triphosphate.

The relationships between respiratory activity and accumulation dynamics of microneustonic communities in the surface microlayer were studied. Surface microlayers collected in the northwestern Mediterranean Sea showed significant enrichment

of particulate organic carbon (POC), ATP, chlorophyll, muramic acid (a specific bacterial biomass indicator) and total viable bacterial count. Mean enrichment factors for muramic acid (52.6) and total bacterial count (38.4) were clearly higher than that for chlorophyll (19.8). Although phytoneuston and bacterio-neuston appeared to have lower ATP levels, particularly in brackish water areas, compared with plankton, the bacterioneuston exhibited higher viability than bacterioplankton found in the corresponding underlying waters. Biochemical oxygen demand (BOD) and electron transport systems (ETS) measurements clearly showed enhanced respiratory activities (up to 765.1 microliter o2/l/h) in the microlayers compared to underlying bulk waters. Data comparison between BOD, ETS, POC, salinity and microbiomass estimates suggests that the measured respiratory activities (BOD and ETS) were well associated with bacterial populations in both the microlayer and bulk waters. (Author's abstract)
W89-10541

IS THE LOWER HUDSON-RARITAN ESTUARY A SUITABLE HABITAT FOR GONYAULAX TAMARENSIS,
National Marine Fisheries Service, Highlands, NJ. Sandy Hook Lab.
J. B. Mahoney, D. Hollomon, and R. Waldhauer.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 179-186, November 10, 1988. 1 fig, 5 tab, 43 ref.

Descriptors: *Estuaries, *Bays, *Dinoflagellates, *Gonyaulax, *Aquatic habitats, Metals, Water quality, Bioassay, Nutrients, Nitrogen, Phosphorus, Vitamins.

A series if bioassays were conducted on water collected from two locales in Lower New York Bay from July through September, the usual period of flagellate maxima. In the assays, Gonyaulax tamarensis growth regulation by nitrogen, phosphorous and vitamins was relatively unimportant, less important than that of one or more components of a metals mix. Nitrogen had a primary limiting role or shared primary importance with other enrichments in just 7% and 18% of the assays, respectively; phosphorous and vitamins were less limiting. Growth inhibition in the assays, which could be relieved by chelation and/or treatment of the water with activated carbon, was prevalent. Assuming the persistence of similar chemical water quality in Lower New York Bay, the results suggest that, although nutrient limitation of G. tamarensis would be improbable, this habitat would not be generally favorable. However, because the dinoflagellate grew relatively well in the unenriched, untreated bay water in 20% of the assays, and at least survived in most of the remainder, the chemical water quality does not appear to exclude it. It is concluded that G. tamarensis is unlikely to become a principal resident phytoplankter in the bay, assuming its introduction, but it may be able to establish itself temporarily when the water quality is favorable for all species. (Author's abstract)
W89-10543

EFFECTS OF SEDIMENT ORGANICS, DETRITAL INPUT, AND TEMPERATURE ON DEMOGRAPHY, PRODUCTION, AND BODY SIZE OF A DEPOSIT FEEDER,
State Univ. of New York at Stony Brook. Dept. of Ecology and Evolution.
J. S. Levinton, and S. Stewart.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 3, p 259-266, November 30, 1988. 5 tab, 4 fig, 21 ref. National Science grant OCE8509539.

Descriptors: *Marine environment, *Sediments, *Estuaries, *Organic matter, *Temperature effects, Detritus, Aquatic plants, Spartina, Ulva, Carbon, Nitrogen, Biomass, Dynamics.

In spring, organic detritus enters temperate marine nearshore habitats during a period of changing temperature and often shifting detrital quality. The interacting roles of sedimentary organic matter, detrital quality (Spartina versus Ulva input), and varying temperature on the population dynamics and biomass productivity of the common nearshore oligochaete Paranais litoralis was investigated. During the phase of population increase, detrital input had the same positive effects on population size, irrespective of the specific detrital type or temperature. Later, however, the populations overexploited available resources, and crashes occurred in the order: (1) high temperature-Spartina, (2) low temperature-Spartina, (3) high temperature-Ulva, and (4) low temperature-Ulva. In contrast, biomass productivity was negatively affected by temperature. Carbon and nitrogen analyses of the sediment, detritus, and worms were used to calculate the nutritional value of the sedimentary carbon and nitrogen. At 15 C, 0.8% of the nitrogen in the sediment was usable by the worms, while the conversion efficiency on detritus was 20 to 30%. For carbon, about 0.2% of the sediment was converted, whereas about 5% of the detrital carbon was converted. These numbers are somewhat lower at 25 C. Results suggest that the overwhelming majority of carbon and nitrogen in the sediment is useless for deposit feeder production. The large absolute amount, however, still may subsidize considerable deposit feeder production. In effect, a small percentage conversion, multiplied by a large availability, results in a considerable yield from the sedimentary organic matter. Pulses of detrital addition, however, may be nutritionally valuable. (Author's abstract)
W89-10544

INFLUENCE OF RUNOFF ON INTERTIDAL MUDFLAT BENTHIC COMMUNITIES,
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5C.
W89-10545

REPRODUCTIVE CONDITION OF DUNGENESS CRABS, CANCER MAGISTER, AT OR NEAR LOG TRANSFER FACILITIES IN SOUTHEASTERN ALASKA,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
For primary bibliographic entry see Field 5C.
W89-10546

EFFECT OF SALINITY ON THE MICROBIAL MINERALIZATION OF TWO POLYACRYLIC AROMATIC HYDROCARBONS IN ESTUARINE SEDIMENTS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
For primary bibliographic entry see Field 5B.
W89-10550

SPATIAL VARIATIONS IN THE SULFUR CHEMISTRY OF SALT MARSH SEDIMENTS AT NORTH INLET, SOUTH CAROLINA,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 2J.
W89-10565

ORIGIN AND MORPHOLOGY OF THE COASTAL LAGOONS OF RIO GRANDE DO SUL, BRAZIL (GENESE E MORFOLOGIA DAS LAGOAS COSTEIRAS DO RIO GRANDE DO SUL, BRASIL),
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
For primary bibliographic entry see Field 2H.
W89-10595

SUBLITTORAL MACROBENTHIC INFAUNAL ASSEMBLAGES OF TWO NEARBY EMBAYMENTS FROM CENTRAL CHILE,
Concepcion Univ. (Chile). Dept. de Oceanologia.
F. D. Carrasco, V. A. Gallardo, and S. Medrano.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 441-455, 1988. 4 fig, 7 tab, 36 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Marine environment, *Chile, *Bays, Bottom sediments, Species composition, Spatial distribution, Concepcion Bay, San Vicente Bay.

The benthic assemblages in two Central Chile embayments were studied from quantitative samples collected from 15 sites at depths of 8-65 m. The macrobenthic infauna (>0.5 mm) of both bays was greatly dominated by polychaetes. Some 93 taxa were identified, of which 51 were polychaetes. The average macrofaunal abundance for all stations (15,021 ind./sq m) is very close to the values reported for the neighboring areas. Numerical classification and ordination of sites resulted in three site-groups mostly reflecting differences in the bottom sediments: the muddy-bottom stations of Concepcion Bay and the shelf-associated stations, the sandy-bottom stations of San Vicente Bay and a heavily polluted station at San Vicente port. Classification of species showed that the muddy-bottom stations and the sandy-bottom sites had characteristic species assemblages. The macrofaunal assemblages presented high dominance values, which were due to the high numerical abundances of a few species in the collections. (Author's abstract)
W89-10620

NITROGEN AS A FACTOR AFFECTING ALGAL GROWTH POTENTIAL OF AN OLIGOTROPHIC COASTAL ENVIRONMENT OF EASTERN MEDITERRANEAN SEA,
Democritos Nuclear Research Center, Athens (Greece).
L. Ignatiades, and N. Moschopoulou.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 457-464, 1988. 2 fig, 5 tab, 36 ref.

Descriptors: *Limiting nutrients, *Marine algae, *Marine environment, *Phytoplankton, *Algal growth, *Nutrients, *Nitrogen, *Oligotrophy, Chlorophyll a, Aegean Sea, Mediterranean Sea, Ammonium, Bioassay, Coastal waters.

The potential nitrogen limitation to chlorophyll a production in surface waters of Saronicos Gulf, Aegean Sea, was assayed using the alga Pavlova lutheri as the test organism. The oligotrophic and eutrophic water types of this area were compared by in situ and in vitro chlorophyll a production estimations. Additions of ammonium alone as well as in combination with complete nutrient enrichment were made to the oligotrophic waters, and the algal growth yield was determined and compared with the corresponding yield in unenriched water cultures. The results from routine nutrient analysis and bioassay experimentation support the view that nitrogen has a priority among the factors limiting phytoplankton growth in the Eastern Mediterranean Sea. (Author's abstract)
W89-10621

SELECTING FACTORS IN POLYCHAETE COMMUNITIES OF CENTRAL MEDITERRANEAN COASTAL LAGOONS,
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
M. F. Gravina, G. D. Ardizzone, and A. Giangrande.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 73, No. 4, p 465-476, 1988. 6 fig, 2 tab, 34 ref.

Descriptors: *Coastal lagoons, *Polychaetes, Species distribution, Salinity, Trophic level, Mediterranean Sea, Italy, Multivariate analysis, Brackish water, Ordination model.

The Polychaete communities of six coastal lagoons of Central italy were studied. Descriptive and multivariate analyses were carried out in order to explain the main environmental factors influencing the Polychaete distribution pattern. The 40 sites sampled represent a wide range of ecological situations, from those mostly influenced by the sea towards the insulated ones, through different trophic conditions. All the stations were sampled in January, April, July and October in order to provide evidence for seasonal variations. Forty-two species of Polychaetes were identified, most of them marine species often occurring in sheltered coastal areas, some opportunistic and others typical of brackish waters. The multidimensional anal-

ysis gave evidence for two main gradients in the ordination models obtained, whose mostly important descriptive factors were salinity and trophic status. Therefore two main environmental factors, namely marine influence (i.e. sea-lagoon exchange) and eutrophic inputs (as measure of the inflow of freshwater) appeared to play an important role in influencing the Polychaete distribution of the investigated coastal lagoons. (Author's abstract)
W89-10622

PHOTO-OXIDATION OF DISSOLVED ORGANIC MATTER FOR TRACE METAL ANALYSIS,
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 7B.
W89-10636

INTERPRETATION OF TRANSIENT PORE PRESSURES IN SALT MARSH SEDIMENT,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. K. Nuttle.
Soil Science SOSCAK, Vol. 146, No. 6, p 391-402, December 1988. 10 fig, 2 tab, 14 ref. NSF Grant No. BSR 8306433, MIT Sea Grant College Program NOAA, Office of Sea Grant No. NA84AA-D-00046.

Descriptors: *Wetlands, *Salt marshes, *Sediment-water interfaces, *Pore pressure, Hydraulic properties, Lysimeters, Flow models, Mass balance equations, Specific storage, Hydraulic conductivity, Massachusetts.

The hydraulic properties of salt marsh sediments can be estimated by analyzing the transient pore pressure response that follows the addition of water to the surface of the sediment. This method is demonstrated for pore pressures observed in a lysimeter containing a 137 L sample of sediment from Belle Isle Marsh in Boston, MA. The specific storage, also called differential moisture capacity, of the sediment is determined from the net change in pressure at equilibrium following the addition of a known volume of water, and the hydraulic diffusivity, the ratio of hydraulic conductivity to specific storage, is determined from the time scale over which transient pressure conditions persist. The linearized mass balance equation is the basis for the interpretation of the transient time scale, even though the linear theory is a relatively poor representation of the actual conditions in the sediment. Numerical simulations with a saturated-desaturated flow model show that estimates of hydraulic conductivity are not severely biased by the approximate nature of the linear theory underlying the interpretation of the pressure data. The specific storage of the sediment sample was found to be 0.0005/cm, and the saturated hydraulic conductivity was 0.0005 cm/s. Effects of desaturation on the hydraulic properties were observed below an apparent air-entry threshold of -10 cm. Estimates of the specific storage followed an unexpected trend as conditions in the sediment became more unsaturated, possibly caused by the macroporosity of salt marsh sediment. (Author's abstract)
W89-10645

LIGHT RESPONSES OF A SUBMERSED MACROPHYTE: IMPLICATIONS FOR SURVIVAL IN TURBID TIDAL WATERS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2I.
W89-10651

NATURAL TRACE METAL CONCENTRATIONS IN ESTUARINE AND COASTAL MARINE SEDIMENTS OF THE SOUTHEASTERN UNITED STATES,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 2K.
W89-10655

DEGRADATION OF MANGROVE LEAVES IMMERSED IN THE ESTUARY OF NAKAMA RIVER, OKINAWA,
Kochi Univ. (Japan). Faculty of Agriculture.
S. Angsupanich, H. Miyoshi, and Y. Hata.
Nippon Suisan Gakkaishi NSUGAF, Vol. 55, No. 1, p 147-151, January 1989. 4 fig, 2 tab, 15 ref.

Descriptors: *Mangrove swamps, *Decomposing organic matter, *Estuarine environment, Plant tissues, Amino acids, Dry matter, Carbohydrates, Japan, Leaves.

The fate of four kinds of mangrove leaves immersed in mid and lower estuaries of Nakama River, Iriomote Island, Okinawa, was examined using a litter bag technique. The times required for loss of half the initial ash-free dry weight of immersed leaves were 13-16 days for Avicennia marina, 17-18 days for Rhizophora stylosa, 24-34 days for Sonneratia alba and 52-65 days for Bruguiera gymnorrhiza. The rates of degradation of mangrove leaves immersed in the lower estuary appeared to be slightly faster than those immersed in the mid-estuary. Non-cellulose carbohydrate contents of the decaying leaves were about 3-20% of the corresponding ash-free dry weight which tended to decrease towards the end of the experiment. On the contrary, the levels of the amino acid contents in the decaying leaves were rather complex and apparently increased during some periods of immersion except the case of A. marina. (Author's abstract)
W89-10660

ECOLOGICAL STATUS OF THE SEDIMENT COMMUNITIES OF CASTRIES HARBOUR, ST LUCIA, WEST INDIES,
Caribbean Environmental Health Inst., Castries (St. Lucia).
For primary bibliographic entry see Field 5C.
W89-10662

ECOLOGICAL PLANNING: A POSSIBLE METHOD FOR THE CHOICE OF AQUACULTURAL SITES,
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
For primary bibliographic entry see Field 6A.
W89-10664

SEDIMENT-WATER EXCHANGE OF DISSOLVED NUTRIENTS AT AN INTERTIDAL SITE IN THE UPPER REACHES OF THE BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
P. D. Keizer, B. T. Hargrave, and D. C. Gordon.
Estuaries ESTUDO, Vol. 12, No. 1, p 1-12, March 1989. 8 fig, 2 tab, 34 ref.

Descriptors: *Estuaries, *Sediment-water interfaces, *Intertidal areas, *Nutrients, Nitrates, Phosphates, Silicates, Phytoplankton, Algae, Primary productivity, Suspended particulate material, Cumberland Basin, Bay of Fundy, Canada.

Concentrations of dissolved nitrate, silicate, and phosphate in water flooding intertidal sediments at Pecks Cove and along the axis of Cumberland Basin, Bay of Fundy were measured throughout the year. Exchanges of dissolved nutrients between intertidal sediments and overlying water were measured by enclosing water in chambers over undisturbed sediment. Nitrate concentrations in the water usually decreased during incubations while silicate was released by sediments during summer and consumed during fall. Particles which settled in sediment raps exposed during periods of high tide were stirred in filtered seawater to measure nutrient exchange. The flux of nutrients between the intertidal sediments and settled particles and seawater was estimated from incubation experiments and the observed nitrogen content in surface sediments and suspended particulate material. There was a net import of dissolved nitrate and silicate into Cumberland Basin from Chignecto Bay during early summer; at all other times there was a net export. Despite the low primary productivity and rigorous physical environment, biological activity has a measurable impact on dissolved nutrient concentrations in the waters of Cumberland Basin. (Author's abstract)
W89-10668

MATHEMATICAL MODEL OF THE BROWN TIDE,
State Univ. of New York at Stony Brook. Dept. of Applied Mathematics and Statistics.
E. Beltrami.
Estuaries ESTUDO, Vol. 12, No. 1, p 13-17, March 1989. 3 fig, 8 ref.

Descriptors: *Water pollution effects, *Brown tide, *Coastal waters, *Eutrophication, *Algal growth, *Mathematical models, Computer models, Water temperature, Salinity, Nutrients, Tides, Rainfall, Seasonal variation, Population dynamics, Long Island.

A differential equation model is proposed for brown tide algae blooms in the coastal waters of Long Island which provides a plausible mechanism for the underlying dynamics. Growth rates depend on annual variations in temperature and salinity. The maximum population density is effectively limited by the availability of a favorable concentration of nutrients, together with zooplankton grazing. Salinity depends on rainfall while nutrient concentration is influenced by tidal flushing. The first of these factors is aperiodic, the second periodic, in time. The resulting nonlinear model distinguishes between 'fast' algae growth and 'slow' long-term changes in nutrients and salinity. Because of this, one can show that explosive increases of algae densities will occur infrequently at sporadic intervals. Computer trials with the model appear to replicate many, if not all, of the essential features of the observed bloom. (Author's abstract)
W89-10669

SEDIMENT ACCUMULATION AT A FRINGE MARSH DURING TRANSGRESSION, OYSTER, VIRGINIA,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. F. Oertel, G. T. F. Wong, and J. D. Conway.
Estuaries ESTUDO, Vol. 12, No. 1, p 18-26, March 1989. 4 fig, 3 tab, 12 ref.

Descriptors: *Paleolimnology, *Sedimentation, *Water level fluctuations, *Sea level, *Wetlands, *Tidal marshes, Fringe marshes, Tides, Lead radioisotopes, Geochronology, Outwash, Virginia, *Geomorphology.

A variety of processes and sources account for the total accumulation of sediment on a fringe marsh. The rates of accretion across Brockenberry fringe marsh at the south end of the Delmarva Peninsula, Virginia, were determined by Pb-210 radiogeochronology. Rates are governed by the surface elevation with respect to mid-tide elevation, the rate of sea level rise, and outwash from the mainland. Only some portions of the fringe marsh are able to keep pace with sea level rise and thus migrate up the mainland slope during transgression. (Author's abstract)
W89-10670

MEASUREMENTS OF CORDGRASS, SPARTINA ALTERNIFLORA, PRODUCTION IN A MACROTIDAL ESTUARY, BAY OF FUNDY,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Dept. of Fisheries and Oceans.
P. J. Cranford, D. C. Gordon, and C. M. Jarvis.
Estuaries ESTUDO, Vol. 12, No. 1, p 27-34, March 1989. 4 fig, 2 tab, 13 ref.

Descriptors: *Bay of Fundy, *Canada, *Estuaries, *Salt marshes, *Tidal marshes, *Marsh plants, *Spartina, *Tidal floods, *Primary productivity, Plant growth, Population dynamics, Minas Basin.

A one-year field study was conducted of the growth, mortality, and loss dynamics of a Spartina alterniflora low marsh in the Minas Basin, a macrotidal estuary at the head of the Bay of Fundy. Data were used to examine the suitability of four methods for estimating annual net aerial primary production (NAPP) of a marsh subject to energetic tidal flooding. Shoots start to grow in April and

reach maximum height (about 0.5 m) and weight in October. Maximum shoot density (900-1600/sq m) occurs around June and drops thereafter due to the export of entire shoots. The average shoot produces about seven leaves and at least 2-3 are lost during the growing season. All remaining vegetation dies before the end of November. Methods based on harvesting vegetation underestimated NAPP, especially at lower elevations where export is greater due to more frequent and prolonged tidal flooding. The highest NAPP values, on the order of 500-600 g/sq m/yr, were obtained using methods based on the population dynamics of individual shoots. These methods are recommended for energetic tidal environments because they include the production of vegetation exported during the growing season. (Author's abstract)
W89-10671

EFFECTS OF HYDROCARBONS ON THE SETTING OF THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA, IN INTERTIDAL HABITATS IN SOUTHEASTERN NORTH CAROLINA,
North Carolina Univ., Wilmington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-10672

STABLE CARBON ISOTOPIC EVIDENCE FOR SOURCES OF PARTICULATE ORGANIC CARBON FOUND IN SEA FOAM,
South Carolina Univ., Columbia. Marine Science Program.
S. L. Harden, and D. F. Williams.
Estuaries ESTUDO, Vol. 12, No. 1, p 49-56, March 1989. 6 fig, 1 tab, 42 ref.

Descriptors: *Bubbles, *Isotope studies, *Particulate matter, *Phytoplankton, *Algae, *Organic carbon, *Sea foam, Particulate organic carbon, Organic matter, Stable carbon isotopes, Seasonal variation, South Carolina.

Particulate organic carbon (POC) found in sea foam and water samples from North Inlet, South Carolina, were examined for their delta-carbon-13 isotopic composition. Sea foam POC delta-carbon-13 values ranged from -20.4 to -24.6 per mil (mean =-22.3) and water POC delta-carbon-13 values ranged from -21.0 to -28.5 per mil (mean = -22.4). Temporal trends in sea foam and water POC indicate that delta-carbon-13 values for both POC components are depleted in the colder months and enriched in the warmer months. Measurement of delta-carbon-13 from potential sources for organic matter found in sea foam, combined with data on macroalgae productivity and phytoplankton biomass, indicates that macroalgae are the principle source of POC for sea foam in the colder months. In the warmer months, phytoplankton appear to be more important contributors. The observed water POC delta-carbon-13 values were always depleted relative to foam POC delta-carbon-13 values. This isotopic difference may result from chemical segregation during sea foam formation or may reflect dissolved organic carbon delta-carbon-13 values from terrestrial origins. (Author's abstract)
W89-10673

SIMPLE MODEL SYSTEM FOR SMALL SCALE IN VITRO STUDY OF ESTUARINE SEDIMENT ECOSYSTEMS,
Aberdeen Univ. (Scotland). Dept. of Genetics and Microbiology.
For primary bibliographic entry see Field 5B.
W89-10702

SALTMARSH PONDS--A PREFERRED HABITAT FOR MAGNETOTACTIC BACTERIA,
Bath Univ. (England). School of Chemistry.
N. H. C. Sparks, J. Lloyd, and R. G. Board.
Letters in Applied Microbiology LAMIE7, Vol. 8, No. 3, p 109-111, March 1989. 1 fig, 1 tab, 11 ref.

Descriptors: *Wetlands, *Aquatic bacteria, *Iron bacteria, *Magnetotactic bacteria, *Salt marshes, *Intertidal areas, Littoral environment, Aquatic habitats, Ecological distribution.

Magnetotactic bacteria synthesize intracellular crystals of the magnetic iron oxide, magnetite. The crystals are aligned within the cell where they function as a bar magnet, orienting the cell such that flagella action will propel it along the geomagnetic field. Although considered to be ubiquitous, very little is known about their ecology. The aim of this survey was to identify a habitat particularly suited to these organisms. Sediment and the overlying water samples were collected from 67 fresh and 38 salt water sites in the UK. Only 13% (5) of the samples taken from salt water sites were negative for magnetotactic bacteria compared with 47.7% (32) of the fresh water sites. Of the 7 types of salt water habitats examined, saltmarsh ponds were found to be most suited to magnetotactic bacteria, 96% (25/26) of sites being positive. (Author's abstract)
W89-10705

PARTICULATE ORGANIC SULFUR IN THE WATERS OF THE SOUTHERN CALIFORNIA BIGHT,
Scripps Institution of Oceanography, La Jolla, CA. Inst. of Marine Resources.
P. A. Matrai, and R. W. Eppley.
Global Biogeochemical Cycles GBCYEP, Vol. 3, No. 1, p 89-103, March 1989. 6 fig, 4 tab, 42 ref. DOE Grants DE-F05-85-ER60336 and DE-FG05085-ER60339. NSF grant OCE86-13685.

Descriptors: *Geochemistry, *Sulfur, *Suspended solids, *Particulate matter, *Bights, Organic compounds, Nitrogen, California, Water column, Chlorophyll a, Organic carbon, Plankton.

The organic sulfur content of suspended and sinking particulate matter was examined in the upper 1000 m of the water column in the Southern California Bight. Depth distributions (POS) showed a subsurface maximum in most stations that deepened offshore. POS concentrations in suspended matter averaged 1.26+or-0.50 micrograms S/l within the euphotic zone during the two cruises analyzed (August and October, 1987). The downward fluxes of mass, carbon, nitrogen and sulfur of sinking particulate matter increased with increasing sample depth to 350 m in the water column. Fluxes were similar during the three deployments. POS was correlated with and directly proportional to particulate organic carbon, particulate organic nitrogen, and chlorophyll a in the suspended material. Similar correlations were obtained in the trap material although a positive POC intercept value suggested the presence of more refractory material, with sulfur being selectively removed relative to carbon. The average molar ratios were C:N:S:=224:27:1 in suspended and 119:17:1 in sinking particulate organic matter. Particulate organic sulfur appeared to have a biological origin, most likely planktonic. (Author's abstract)
W89-10714

DIFFUSIVE FLUX OF METHANE FROM WARM WETLANDS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2H.
W89-10722

METHANE HYDRATES AND GLOBAL CLIMATE,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2H.
W89-10723

CARBON AND HYDROGEN ISOTOPE FRACTIONATION RESULTING FROM ANAEROBIC METHANE OXIDATION,
Alaska Univ., Fairbanks. Inst. of Marine Science.
M. J. Alperin, W. S. Reeburgh, and M. J. Whiticar.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 279-288, September 1988. 5 fig, 50 ref.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Oxidation, *Marine sediments, *Bays, Alaska, Carbon, Hydrogen, Isotopes, Models, Microbial degradation, Path of pollutants.

Methane oxidation in the anoxic sediments of Skan Bay, Alaska resulted in fractionation of carbon and hydrogen isotopes in methane. Isotope fractionation factors were estimated by fitting methane concentration, delta-C13-CH4, and delta-D-CH4 data with depth distributions predicted by an open system, steady state model. Assuming that molecular diffusion coefficients for C12-CH4, C13-CH4, and C12-CH3D are identical, the predicted fractionation factors were 0.0088+or-0.0013 and 1.157+or-0.023 for carbon and hyrdogen isotopes, respectively. If aqueous diffusion coefficients for the different isotopic species of methane differ significantly, the predicted fractionation factors are larger by an amount proportional to the diffusion isotope effect. (Author's abstract)
W89-10724

SEASONAL VARIATIONS IN EBULLITIVE FLUX AND CARBON ISOTOPIC COMPOSITION OF METHANE IN A TIDAL FRESHWATER ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
J. P. Chanton, and C. S. Martens.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 289-298, September 1988.

Descriptors: *Biochemistry, *Geochemistry, *Estuaries, *Methane, *Oxidation, *Microbial degradation, Path of pollutants, Seasonal variation, Bubbles.

Methane carbon isotopic composition ranged from -76.9 to -62.6 o/oo in a tidal freshwater estuary (the White Oak River, North Carolina, United States) with site specific seasonal variations ranging from 6 to 10 o/oo. During warmer months, tidally induced bubble ebullition actively transported this methane to the atmosphere. At two sites, these seasonally varying fluxes ranged from 1.2 +or-0.3 to 1.3 +or-0.3 mol CH4/sq m/yr (19.2 to 20.8 g CH4/sq m/yr), with flux-weighted average isotopic compositions at two sites of -66.3 +or-0.4 and -69.5 +or-0.6 o/oo. The carbon isotopic composition of naturally released bubbles was shown to be indistinguishable from the sedimentary methane bubble reservoir at three sites, leading to the conclusion that isotopic fractionation did not occur during the ebullition of methane. The hypothesis was developed that ebullitive methane fluxes are depleted in C13-CH4 relative to fluxes transported via molecular diffusion or through plants, as zones of C13-enriching microbial methane oxidation are bypassed. (Author's abstract)
W89-10725

HEAVY METALS IN BIVALVE MOLLUSCS IN THE HUELVA ESTUARY,
Instituto Nacional de Toxicologia, Seville (Spain).
For primary bibliographic entry see Field 5B.
W89-10742

BIOLOGICAL AND ABIOTIC DEGRADATION OF XENOBIOTIC COMPOUNDS IN IN VITRO ESTUARINE WATER AND SEDIMENT/WATER SYSTEMS,
Gulf Coast Research Lab., Ocean Springs, MS.
For primary bibliographic entry see Field 5B.
W89-10808

KINETICS OF THE UPTAKE AND ELIMINATION OF POLYCHLORINATED BIPHENYLS BY AN ESTUARINE FISH SPECIES (RHABDOSARGUS HOLUBI) AFTER AQUEOUS EXPOSURE,
Port Elizabeth Univ. (South Africa). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W89-10811

METHOD TO ESTIMATE DIFFUSE INFLOW OF FRESH WATER INTO A COASTAL SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 5B.
W89-10829

HEAVY METALS MONITORING BY THE PIXE TECHNIQUE IN THE COASTAL ZONE OF PORTUGAL,
Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). Dept. de Estudos de Impacte Industrial.
For primary bibliographic entry see Field 5A.
W89-10833

WETLAND MODELLING.
For primary bibliographic entry see Field 2H.
W89-10975

SIMULATION MODELS OF COASTAL WETLAND AND ESTUARINE SYSTEMS: REALIZATION OF GOALS,
Georgia Univ., Sapelo Island. Marine Inst.
C. S. Hopkinson, R. L. Wetzel, and J. W. Day.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 67-97, 9 fig, 27 ref.

Descriptors: *Model studies, *Wetlands, *Estuaries, *Coastal marshes, *Simulation analysis, Marshes, Sensitivity analysis, Ecosystems, Swamps, Hydrologic models.

The most successful models of marsh/estuarine systems are more than an academic exercise in summarizing large data sets. They are also useful tools for formulating new testable hypotheses, for guiding large ecosystem-level research programs and for guiding the management of coastal habitats. Six simulation models of coastal marsh/estuarine systems that are representative of both management and research-directed efforts are reviewed: conceptual models of the Mississippi River deltaic plain region, Des Allemands urban runoff-swamp eutrophication models, Summers-McKeller North Inlet estuarine models, Sapelo Island Salt marsh models, a microbially-linked model of carbon flow in estuarine waterbodies, and North River ecosystem model. The utility of sensitivity analysis as a means to reveal factors controlling certain ecosystem behaviors is analyzed and shown to be strongly limited by the initial abstraction or conceptualization of the ecosystem structure. (See also W89-10975) (Lantz-PTT)
W89-10979

DYNAMIC SPATIAL SIMULATION MODEL OF LAND LOSS AND MARSH SUCCESSION IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. Costanza, F. H. Sklar, M. L. White, and J. W. Day.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 99-114, 5 fig, 33 ref.

Descriptors: *Land loss, *Environmental effects, *Estuaries, *Simulation analysis, *Louisiana, *Marshes, *Coastal marshes, *Model studies, Water resources development, Mathematical models, Mathematical studies, Canals, Levees, Water resources management, Succession.

A spatial simulation model was constructed to help understand the historical changes in the Atchafalaya/Terrebonne marsh/estuarine complex in south Louisiana and to project impacts of proposed human modifications. The model consists of 2,479 interconnected 'cells,' each representing 1 sq km. Variables include water volume and flow, relative elevation, sediment, nutrient, and salt concentrations, organic standing crop, and productivity. The model produces weekly maps of all the state variables and habitat types. Habitat succession occurs in a cell in the model when physical conditions change sufficiently, so that the new conditions better match the 'signature' of another habitat. This chapter: (1) summarizes the history of the Louisiana coastal land loss problem and suggests solutions; (2) briefly discusses the model's structure, data base, and degree of fit with historical data; (3) discusses the uses and implications of the model, particularly as regards the estimation of the impacts of canals and levees on coastal marsh systems; and (4) outlines the potential interface between the model and management agencies to provide solutions to pressing coastal management problems. (See also W89-10975) (Author's abstract)
W89-10980

RECONNAISSANCE SURVEY OF EIGHT BAYS IN PUGET SOUND,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W89-11010

SOME OBSERVATIONS OF EFFECTS FROM POLYCYCLIC AROMATIC HYDROCARBONS (PAH) AND FLUORIDE IN NORWEGIAN MARINE RECIPIENTS OF ALUMINUM SMELTER WASTE,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W89-11013

MATHEMATICAL MODELING FOR OCEAN AND COASTAL WATERS,
Hanover Univ. (Germany, F.R.). Inst. fuer Stroemungsmechanik und Elektronisches Rechnen im Bauwesen.
K. P. Holz.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 327-345, 12 fig, 18 ref.

Descriptors: *Model studies, *Mathematical models, *Coastal waters, *Computers, *Ocean circulation, *Hydraulic models, Fluid mechanics, Information exchange, Information systems, Cost analysis, Computer models, Estuaries.

An overview on the hardware and software situation in the field of 16-bit and 32-bit workstation computers, and problems of software development and applications of mathematical models for ocean and coastal waters, are given. Both are available at reasonable cost today and it is expected, according to estimates from the computer industry, that the prices will go on dropping by about 30% per year. This puts even smaller research groups and consultants into the position of developing and applying mathematical models of oceans and estuaries with reasonable resolutions. At the same time, this situation leads to rapid development in the field of integrated software systems. Models of the North Sea, of the North Frisian Islands, and of a section of coastline are described briefly. Those who are developing such systems are to a much larger extent confronted with software and 'informatics' tools especially as in the near future knowledge-based and expert systems will be interesting topics for research. The necessary tools are available even for small microcomputers. (See also W89-11033) (Friedmann-PTT)
W89-11058

COMPUTER-BASED METHODOLOGY TO DEVELOP THE ECONOMICS OF ENVIRONMENTAL CHANGE WITHIN RIVER-ESTUARY-COASTAL SYSTEMS,
Old Dominion Univ., Norfolk, VA. Coastal Engineering Inst.
D. R. Basco.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 393-402, 4 fig, 5 ref.

Descriptors: *Economic prediction, *Environmental effects, *Rivers, *Model studies, *Computer models, *Estuaries, *Coastal waters, Flood forecasting, Storm surges, Hydraulic models, Economic aspects, Hurricanes, Numerical analysis, Coastal engineering, Model studies, Stochastic process.

Deterministic, analytical, physical or numerical models are combined with stochastic methods to synthetically generate probability statistics for the dependent variables in a river-estuary-coast (REC) system. The methodology, analogous to that developed to predict the potential for coastal flooding (storm surges) from hurricanes, has been utilized by coastal engineering firms to develop coastal flooding maps of most of the United States coastlines in recent years. Other applications of this joint probability methodology are discussed, including those computations of annual solids washoff and sediment budget. Joint probability models such as this are key management tools through which economic value can be rationally assigned to proposed, engineered change to existing natural or modified REC-systems. (See also W89-11033) (Friedmann-PTT)
W89-11062

DRY BEDS AND SMALL DEPTHS IN 2-D CODES FOR COASTAL AND RIVER ENGINEERING,
Grenoble-1 Univ. (France). Centre de Recherche et d'Essais de Machines Hydrauliques.
J. M. Usseglio-Polatera, and P. Sauvaget.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 415-426, 6 fig, 6 ref.

Descriptors: *Dry beds, *Shallow water, *Coastal engineering, *Hydraulic engineering, *Tidal flats, *Flood plains, Hydraulic models, Flood plain management, Numerical analysis, Mathematical equations, Hydraulic properties, Coastal waters, Drying, Korea, Highway effects, Fate of pollutants.

The treatment of dry beds and small depths in 2-D models is a typical real world problem. In coastal engineering, it occurs when extensive tidal flats are covering at incoming tide and uncovering at outgoing tide. In rivers, it concerns flood plains drying and flooding. This is a difficult problem because any inadequate treatment of these areas may induce oscillations and threaten the accuracy throughout the whole computational domain. This is not only a problem of a moving boundary. The conventional shallow water equations are no longer applicable when water becomes very shallow and a specific procedure is necessary. A detailed method is presented, based on physical and numerical statements, that give satisfactory results in very intricate configurations. Real world applications in coastal areas and rivers are presented. In the coastal application, the method was able to account for the fact that the tidal flats of the Kwang Yang Bay (Korea) are covered with devices for mussel breeding and the effect of these devices on the flow patterns. In the river application, the method was able to account for advection-diffusion in modeling for an accidental chemical spill on a super highway planned across a large flood plain. (See also W89-11033) (Friedmann-PTT)
W89-11064

DYNAMICS OF THE HUGLI ESTUARY IN INDIA--NUMERICAL INVESTIGATION,
Hydraulic Study Department, Calcutta Port Trust, Calcutta, India.
A. K. Chatterjee.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 427-437, 3 fig, 5 tab, 3 ref.

Descriptors: *Estuaries, *India, *Hydraulic properties, *Channel morphology, *Harbors, *Flow characteristics, Tidal hydraulics, Port authorities, Optimization, Drainage, River systems, Tidal rivers, River mouth, Monsoons, Navigable rivers, Bank erosion, Dredging.

The Hugli estuary in the state of West Bengal, India, accommodates the Port of Calcutta and the more recently established deep dock system at Haldia at 170 km and 50 km, respectively, inland from the sea. Due to non-availability of desired depths in the navigation channel, full utilization of the dock facilities is not possible, resulting in heavy

financial loss to the port authorities as well as to the country. A comprehensive improvement project is underway to achieve the desired depths. Exhaustive numerical investigation was conducted and is still in progress to predict the morphological changes due to the execution of the necessary massive dredging and river training works. The optimization of these works were also done through numerical investigations. The results of the numerical investigations of the dynamics of the Hugli estuary are highlighted. The estuary drains the major river system of the Bhagirathi-Hugli. It derives its riverine flow from the Ganga and is non-tidal for about 225 km from its source. The source of fresh water in the estuary is the Ganga alone in the non-monsoon months and also from other tributaries during the monsoons. The tides in the estuary are semidiurnal with an average tidal period of 12 h 25 m. The main morphological characteristics appearing to influence the depth in the Auckland area are a receding western bank, unstable sand flats downstream of Nayachara, and submerged flats on the west with unstable distributaries diverting water away from the shipping channel. (See also W89-11033) (Friedmann-PTT)
W89-11065

NUMERICAL PREDICTION OF THE EFFECT OF WATER ABSTRACTION UPON TIDAL CHARACTERISTICS OF THE MEGHNA DELTA,
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
J. U. Chowdhury.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 439-448, 6 fig, 4 ref.

Descriptors: *Competing use, *Deltas, *Model studies, *Mathematical models, *Hydraulic models, *Tidal hydraulics, Tidal range, Hydraulic properties, Hydraulic models, Spring tides, Simulation, Fluctuations, Flow characteristics, Prediction, Numerical analysis.

Tidal flow in the Meghna Delta is simulated using an implicit finite difference model. The delta is represented in the model by 23 branches, 13 junctions, 2 discharge boundaries at upland and 5 water level boundaries at the sea face. Every branch is discretized into a series of alternate water level computation points and discharge computation points using unequal distance step that varies from 3.0 km to 7.5 km. The schematization results in a total of 154 water level points and 133 discharge points. A time step of 30 min is used in the computer simulations. Calibration of the model is based on a 36 hr simulation beginning at 6:00 a.m. on December 10, 1985 and ending at 6:00 p.m. on December 11, 1985. The model is then verified against observations duriag a period of 11 days from 2 March to 12 March, 1986. The model was used to predict the effect of reducing the inflows to the delta. A series of model runs was made with flow reductions varying from 500 cu m/s to 3000 cu m/s. Predictions indicate that the tidal excursion increases, on average, by about 0.2 km per 500 cu m/s of water abstraction. A diagram relating the water withdrawal, distance and tidal excursion during spring tides along the Lower Meghna is presented. A reasonably good simulation of tides in the delta was achieved using this numerical model. (See also W89-11033) (Author's abstract)
W89-11066

PHYTOPLANKTON DYNAMICS OF THE FRESH, TIDAL POTOMAC RIVER, MARYLAND, FOR THE SUMMERS OF 1979 TO 1981: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
For primary bibliographic entry see Field 2H.
W89-11068

LOADS OF SUSPENDED SEDIMENT AND NUTRIENTS FROM LOCAL NONPOINT SOURCES TO THE TIDAL POTOMAC RIVER AND ESTUARY, MARYLAND AND VIRGINIA, 1979-81 WATER YEARS: A WATER-QUALITY STUDY OF THE TIDAL POTOMAC RIVER AND ESTUARY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2E.
W89-11069

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3C. Use Of Water Of Impaired Quality

IRRIGATION AND DRAINAGE STRATEGIES IN SALINITY-AFFECTED REGIONS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-10562

3E. Conservation In Industry

ELECTROPLATING/METAL FINISHING WASTEWATER TREATMENT: PRACTICAL DESIGN GUIDELINES,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 5D.
W89-10934

3F. Conservation In Agriculture

EQUATIONS DESCRIBING SPRINKLER DROPLET VELOCITY,
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
K. P. Thooyamani, and D. I. Norum.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 156-165, April 1989. 2 fig, 6 ref.

Descriptors: *Hydrodynamics, *Fall velocity, *Mathematical studies, *Mathematical equations, *Fluid drops, *Sprinkler irrigation, *Simulated rainfall, Sprinkling, Velocity, Irrigation design, Nozzles, Fluid drops, Mathematical equations.

Sprinklers are a common method of applying irrigation water; however, sprinkler droplets with high impact velocity can produce surface sealing and soil aggregate breakdown that can result in low infiltration rates and high runoff rates. Therefore, the design of a sprinkler irrigation system with high uniformity and application efficiency requires a thorough knowledge of the velocity and displacement of the sprinkler droplets. Sprinklers also are often used to simulate rainfall for soil erosion studies. The kinetic energy per unit area supplied to the soil surface depends upon the droplet size distribution and the impact velocity. Once again, it is necessary to have a good knowledge of the velocity and displacement of the droplets to properly simulate field conditions. Previous investigators have used a graphical method to analyze rate of fall of water droplets through still air to show that the drag force of a water droplet is proportional to the second power of the speed. The equations describing the movement of a droplet in still air were put in dimensionless form (with the terminal speed as the characteristic term) and the analytical solutions are obtained for the horizontal and vertical velocities and displacements of a droplet, given its initial velocity components and the nozzle elevation. The resulting equations may provide a basis for modeling sprinkler distributions. The angle of projection of the droplet as it leaves the nozzle, that results in the maximum horizontal projection of the droplet when landing on a horizontal surface, is obtained as a function of the speed with which the droplet leaves the nozzle and the elevation of the nozzle. This nozzle angle is designated as the optimum angle. (Miller-PTT)
W89-10553

EFFECTS OF DEFICIT IRRIGATION AND IRRIGATION FREQUENCY ON WHEAT YIELDS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. English, and B. Nakamura.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 172-184, April 1989. 5 fig, 6 tab, 10 ref.

Descriptors: *Irrigation practices, *Irrigation, *Irrigation effects, *Crop yield, *Wheat, Irrigation frequency, Costs, Water use efficiency.

Deficit irrigation, the deliberate under-irrigation of a crop, can be a useful management technique for increasing net farm income under some circumstances. Although yields will be reduced under deficit irrigation, the reduction in irrigation costs and the opportunity costs of water may more than compensate for the lower yields. The relationship between wheat yields and irrigation frequency was studied in a set of field experiments. Experimental plots were irrigated at intervals that ranged from two days to four weeks. Six irrigation frequencies were studied: (1) no irrigation other than preirrigation, (2) high frequency (every other day) irrigation, (3) weekly irrigation, and (4) irrigation at extended intervals of two, three and four weeks. Applied water, precipitation, soil water content, and weather factors were measured. The experiments were carried out near Hermiston, Oregon during 1982. The amounts of water applied ranged from 0 to 100% of the full water requirement. High frequency irrigation did not increase yields under full irrigation, nor did it mitigate the effects of deficit irrigation. The highest yields were attained with a relatively long irrigation interval of two weeks. Low irrigation frequencies did not further reduce yields under deficit irrigation. The highest water-use efficiencies were achieved with irrigation intervals of four weeks. (Author's abstract)
W89-10555

OPTIMIZATION MODELS FOR WASTEWATER REUSE IN IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5E.
W89-10556

MODELING YIELDS FROM RAINFALL AND SUPPLEMENTAL IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 2B.
W89-10560

IRRIGATION AND DRAINAGE STRATEGIES IN SALINITY-AFFECTED REGIONS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. K. Gates, and M. E. Grismer.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 255-284, April 1989. 15 fig, 5 tab, 90 ref.

Descriptors: *Saline water, *Irrigation design, *Drainage practices, *Optimum development plans, *Irrigation, *Drainage, *Model studies, Salinity, Aquifers, Simulation models.

A simulation model was developed which accounts for the major processes governing shallow saline water table behavior in salinity-affected irrigated regions. Designed for feasibility-stage project planning, the model may be used to develop economically optimal irrigation and drainage strategies for long-term regional management. Incorporation of uncertainty due to regional-scale physical parameter variability places the optimal management problem in a stochastic setting. An application to a system representative of conditions in the Western San Joaquin Valley of California reveals the merits of the model in providing decision makers with a set of alternative strategies for possible implementation in a regional project. This approach, as shown in the example application,

allows system responses to be interpreted with notions of stability and risk. (Author's abstract)
W89-10562

DIRECT LAND GRADING DESIGN OF IRRIGATION PLANE SURFACES,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W89-10563

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W89-10793

SIMNET-MICROCOMPUTER MODELLING OF IRRIGATION, WATER SUPPLY AND WATER DISTRIBUTION SYSTEMS,
City Univ., London (England). Thermo-Fluids Engineering Research Center.
For primary bibliographic entry see Field 7C.
W89-11034

SYSTEM ANALYSIS OF AN IRRIGATION MAIN CANAL,
Utah State Univ., Logan. Dept. of Chemistry.
A. B. Filali, and W. R. Walker.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 53-64, 1 fig, 4 tab, 9 ref.

Descriptors: *Water conservation, *Irrigation water, *Hydraulic models, *Model studies, *Water supply, *Water demand, *Water policy, *Irrigation canals, Optimization, Algorithms, Hydrographs, Dynamic programming, Upstream, Downstream, Water loss.

The objective of a gravity irrigation system operation model is to give water supply as close as possible to demand with equity and maximum efficiency. By a dynamic programming algorithm, the model identifies optimal water supply policy, taking system inflows to be segregated into optimal supply hydrographs at each command area outlet. The optimization process is handled such that water losses are minimized and water distribution performed well where both upstream and downstream users get the same priority of water supply, according to their internal conditions. The model incorporates the lagtime and the demand updating process in a manner that gives real time to time operation of gravity irrigation networks. The Boufatma single branch irrigation system in Morocco illustrates the application of this method. (See also W89-11033) (Friedmann-PTT)
W89-11038

MOST ECONOMICAL PIPE TYPE OF A SPRINKLER SYSTEM,
Technical Inst. of Agriculture, Mussaib-Babylon. (Iraq). Dept. of Water Projects.
S. T. Azzawi.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 91-99, 5 fig, 7 ref.

Descriptors: *Irrigation efficiency, *Model studies, *Computer models, *Optimization, *Economic aspects, *Sprinklers, *Pipes, *Hydraulic systems, Hydraulic properties, Networks, Computer programs, Sprinkler irrigation, Pumps.

A linear programming model based on the simplex method was developed to optimize the economical design of a sprinkler irrigation system. PVC, aluminium and galvanized steel pipe systems were studied to show the most economical pipe type. A range of pump pressures were applied to the program to indicate the change in design and cost of such systems. Hydraulic properties and economic factors were studied in designing a pipe network. The solution to the system was obtained by changing the length, diameter and type of various subsegments of pipe for various pressures of pump to minimize the capital and pumping costs. The design of the sprinkler system was optimized by linear programming. Two types of data were separately substituted into the program for partial or total computer use: partial use for application of one value of pump pressure in each run of the program, and total use for application of a variable pump pressure into the program. The relation between pump pressures and total annual costs was found. The results show that pump pressure must be variable in the programming model to get the optimal design and the PVC system is the most economical of all types studied. (See also W89-11033) (Friedmann-PTT)
W89-11041

DEVELOPING AN INTERACTIVE HYDRAULIC SIMULATION AND OPERATION MODEL FOR BRANCHING CANAL NETWORKS,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
F. N. Gichuki.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 231-240, 3 fig, 4 ref.

Descriptors: *Irrigation operation, *Simulation, *Irrigation canals, *Model studies, *Computer models, *Hydraulic systems, *Hydraulic models, Hydraulic properties, Conveyance structures, Canals, Computer programs, Networks, Dynamic programming.

Operating a manually controlled canal network as a dynamic entity is a difficult task due to temporal and spatial variabilities in flow. A major bottleneck is the lack of sufficient knowledge and time required to analyze a wide range of feasible operating conditions and selection of the appropriate one. In view of the need for an appropriate irrigation canal management technology, this study yielded a comprehensive multi-disciplinary simulation model that can be used in analyzing the canal network operation decisions required to react to demand changes. Interactive simulation principles are applied in the development of a branching canal network hydraulic model. The program is menu-driven, it has a built-in 'help' explanation that can be called at any point in the simulation process, it traps data entry errors and it has a graphical display of input and simulation status. Interrupt capability is provided to enable the user to pause simulation, critically examine the simulation status, modify and model parameters, and proceed with the simulation. (See also W89-11033) (Author's abstract)
W89-11050

APPLICATION OF A NUMERICAL IMPLICIT MODEL TO AN IRRIGATION CANAL,
Technical Univ. of Lisbon (Portugal). Dept. de Engenhaira Rural.
M. Rijo, L. S. Pereira, and A. B. Almeida.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 275-286, 6 fig, 17 ref.

Descriptors: *Computer models, *Model studies, *Unsteady flow, *Irrigation canals, *Mathematical studies, *Hydraulic properties, Discharge hydrographs, Case studies, Gradually-varied flow, Flow channels, Sensitivity analysis, Algorithms, Numerical analysis, Irrigation operation.

A case study is presented regarding an application of a computational model to the unsteady flow in an irrigation canal, using an implicit numerical technique. The Saint-Venant equations of continuity and momentum for one-dimensional, gradually varied flow were written in a finite-difference form. The system of equations was solved by the double-sweep algorithm. A computer program was written to solve the problem in which a discharge hydrograph is given at the upstream boundary of the canal and a time-dependent water level is specified at the downstream boundary. The model was validated by field tests. A sensitivity analysis was also made concerning the numerical weighting parameter value and the choice of the time step in order to improve the model accuracy. This model will be the basis for an improved canal management in the near future. (See also W89-11033) (Author's abstract)
W89-11054

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

DIRECT LAND GRADING DESIGN OF IRRIGATION PLANE SURFACES,
Lakehead Univ., Thunder Bay (Ontario). Dept. of Civil Engineering.
S. M. Easa.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 285-301, April 1989. 13 ref, append. 6 fig, 1 tab.

Descriptors: *Grading, *Irrigation design, *Terracing, *Land use, *Design standards, *Grading, Irrigation, Computer programs.

Existing land grading design methods involve trial and error procedures to determine the plane that balances cut and fill volumes, considering the shrinkage of soil, to minimize earthwork. Simple formulas for direct land grading design that eliminates the need for trial and error procedures are presented. The design formulas explicitly consider specifications which may include: (1) two edge slopes of the plane, (2) one edge slope and a control point, or (3) two control points. The formulas are based on the assumption that the before and after-grading volumes measured from a reference elevation are equal; the computed plane provides equal cut and fill volumes. Adjustment factors to account for the shrinkage of soil are then developed and can be applied to directly determine the position of the plane that satisfies the required cut/fill volume ratio. Application of the complete design procedure is illustrated by a numerical example. The method allows the field to be divided into rectangular and triangular grids. The rectangular scheme gives the user some flexibility in selecting the grid points to correspond to the changes in ground profile. In this case, the cut and fill volumes of the grids are calculated using the three-point method. The design formulas and adjustment factor for shrinkage are applicable to any field shape that can be divided into rectangle and/or triangles. Land grading design with this method can be performed manually using hand calculators and the design procedure can be readily translated to a computer or calculator program. (Miller-PTT)
W89-10563

STATISTICAL ESTIMATION OF EXTREME FLOOD FLOWS USING CONFIDENCE INTERVALS,
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 2E.
W89-10687

ECOLOGICAL IMPACTS OF INTER-BASIN WATER TRANSFERS: SOME CASE STUDIES, RESEARCH REQUIREMENTS AND ASSESSMENT PROCEDURES IN SOUTHERN AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W89-10769

ESTIMATING PEAK DISCHARGES OF SMALL, RURAL STREAMS IN MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W89-10955

FLOODS OF OCTOBER 1977 IN SOUTHERN ARIZONA AND MARCH 1978 IN CENTRAL ARIZONA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2E.
W89-10958

STUDIES ON ROUTING OF FLOODS IN EPHEMERAL CHANNELS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-11055

FINITE ELEMENT TWO-DIMENSIONAL MODEL FOR FREE SURFACE FLOWS: VERIFICATION AGAINST EXPERIMENTAL DATA FOR THE PROBLEM OF THE EMPTYING OF A RESERVOIR DUE TO DAM-BREAKING,
Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica.
For primary bibliographic entry see Field 2E.
W89-11056

NUMERICAL MODELING OF DAM-BREAK FLOOD FORECASTING WAVE,
Institute of Technology, Baghdad (Iraq). Dept. of Irrigation.
For primary bibliographic entry see Field 2E.
W89-11057

4B. Groundwater Management

NEW DRAIN FLOW FORMULA,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 2F.
W89-10558

REMOTE SENSING APPLICATIONS IN WATER RESOURCES PROSPECTING AND MANAGEMENT,
International Bank for Reconstruction and Development, Washington, DC. Water and Telecommunications Div.
For primary bibliographic entry see Field 7B.
W89-10792

REALITIES OF WELLHEAD PROTECTION,
Caswell, Eichler and Hill, Inc., West Topsham, VT.
For primary bibliographic entry see Field 5G.
W89-10807

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA: PHASE 2--EFFECTS OF PUMPING ON WATER LEVELS AND ON WATER QUALITY IN THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, San Diego, CA.
P. Martin.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2197, 1984. 31p, 12 fig, 8 tab, 20 ref.

Descriptors: *Santa Barbara Basin, *California, *Groundwater management, *Groundwater quality, *Water resources development, *Environmental effects, *Saline water intrusion, Groundwater mining, Groundwater budget, Chlorides, Aquifers, Artificial recharge, Coastal aquifers.

From July 1978 to January 1980, water levels in the southern part of the Santa Barbara groundwater basin declined more than 100 feet. These water level declines resulted from increases in municipal pumping since July 1978 as part of a basin testing program designed to determine the usable quantity of groundwater in storage. The pumping, centered in the city < 1 mile from the coast, has caused water level declines to altitudes below sea level in the main water bearing zones. As a result, the groundwater basin would be subject to saltwater intrusion if the study period pumpage were maintained or increased. Saltwater intrusion has degraded the quality of the water yielded from six coastal wells. During the study period, the six coastal wells all yielded water with chloride concentrations in excess of 250 mg/L, and four of the wells yielded water with chloride concentrations in excess of 1,000 mg/L. Results of this study indicate that ocean water has intruded the deeper water bearing deposits, and to a much greater extent than in the shallow part of the aquifer. Apparently the offshore fault is not an effective barrier to saltwater intrusion. No physical barriers are known to exist between the coast and the municipal well field. Therefore, if the pumping rate maintained during the basin testing program were continued, the degraded water along the coast could move inland and contaminate the municipal supply wells. The time required for the degraded water to move from the coast to the nearest supply well is estimated, using Darcy's equation, to be about 20 years. Management alternatives for controlling saltwater intrusion in the Santa Barbara area include: decreasing municipal pumping, increasing the quantity of water available for recharge by releasing surplus water from surface reservoirs to Mission Creek, artificially recharging the basin using injection wells, and locating municipal supply wells farther from the coast and spacing them farther apart in order to minimize drawdown. (Lantz-PTT)
W89-10949

CONNECTOR WELL EXPERIMENT TO RECHARGE THE FLORIDAN AQUIFER, EAST ORANGE COUNTY, FLORIDA,
Geological Survey, Austin, TX.
P. W. Bush.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2210, 1983. 26p, 18 fig, 1 tab, 9 ref.

Descriptors: *Groundwater management, *Groundwater budget, *Floridan Aquifer, *Groundwater recharge, *Connector wells, *Florida, Aquifers, Groundwater movement, Shallow aquifers, Potentiometric level, Transmissivity.

An experimental connector well, screened in the shallow sand aquifer, finished with open hole in the Floridan aquifer and cased through the confining layer between the two aquifers, was drilled in east Orange County, FL, to obtain information on the nature and function of the shallow aquifer as related to connector well operation. The potentiometric surface of the shallow aquifer is about 45 ft higher than the potentiometric surface of the Floridan aquifer; hence water flows by gravity from the shallow aquifer to the Floridan aquifer through the well 'connecting' the two aquifers. Continuous flow measurement over 10 months shows the well discharge varies seasonally and averages slightly > 50 gal/min. Observation wells show that, except for seasonal variation, water levels within the area of influence have reached steady state within measurable limits. Vertical anisotropy in the shallow aquifer is apparently caused by the shape and/or arrangement of the sand grains that comprise the shallow aquifer, rather than because of distinct confining layers of different lithology. Transmissivity of the shallow aquifer at the site is about 600 sq ft/day. Extensive dewatering of wetlands in east Orange County by connector wells alone probably is not feasible. Nevertheless, large amounts of water could be channeled to the Floridan aquifer by connector wells. The results of the connector well experiment imply that water is being captured from evapotranspiration and interception of water that would have discharged to swamps in the vicinity of the connector well. However, the data available from this experiment do not permit a quantitative expression of the net gain in recharge to the Floridan Aquifer resulting from operation of the connector well. (Author's abstract)
W89-10952

WELL DEVELOPMENT AND HYDRAULIC TESTING AT LLNL SITE 300: BUILDING 830, 834, 840 AND GSA AREAS.
Weiss Associates, Oakland, CA.
For primary bibliographic entry see Field 2F.
W89-11001

AQUIFER SIMULATION FOR OPTIMUM WATER YIELD,
Mosul Univ. (Iraq). Coll. of Engineering.
H. R. Rasheed, H. Al-Anaz, and N. Tawfeek.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 27-34, 2 fig, 7 ref.

Descriptors: *Optimal yield, *Model studies, *Computer models, *Aquifers, *Groundwater mining, *Simulation analysis, *Irrigation water, Available water, Water yield improvement, Optimization, Crop production, Irrigation efficiency, Aquifer characteristics.

A computer model has been developed to estimate the optimal utilization of groundwater resource in conjunction with a dual irrigation practice in a 2000 sq km agricultural area. The model allows continuous and dynamic assessment of the groundwater basin based on the limited initial data (existing well data, logs, pumping tests, drawdown data, geologic information, water quality, economic pumping lifts, power availability, costs, take off points, meteorological records, irrigation methods and efficiencies, crop types, growing season records) and on additional information that becomes available through step-wise development in the region. The initial results obtained from the implementation of the program reveal that more than 50% of the available area can be irrigated in summer and the full area can be put under supplemental irrigation in winter. Step-wise irrigation development is suggested in the area through drilling additional wells in stages. (See also W89-11016) (Geiger-PTT)
W89-11019

PREDICTING REGIONAL GROUNDWATER LEVELS BY THREE-DIMENSIONAL NUMERICAL MODELS,
Padua Univ. (Italy).
P. Mazzalai, and S. Odorizzi.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 1, Groundwater and Aquifer Modelling. Computational Mechanics Publications, Boston. 1988. p 35-46, 12 fig.

Descriptors: *Regional planning, *Model studies, *Mathematical models, *Groundwater level, *Italy, *Groundwater mining, Numerical analysis, Hydrologic models, Test wells, Hydraulic properties, Automation, Hydrologic data collections, Infiltration, Drainage, Monitoring, Prediction, Italy.

A three-dimensional numerical model is proposed to forecast how the groundwater surface at the Sarca Valley in Italy (river basin of 1048 sq km) should change after the interception and the diversion of the stream flow of the main river and after the water extraction increase from the alluvial deposit. The geological and hydrologic conditions have been surveyed in detail. Eleven drilled holes and wells were used in order to measure the groundwater levels and to obtain the in situ hydraulic and geotechnical parameters of the aquifers. A comprehensive geohydrologic monitoring program was also established in 1985 (automatic data collection and recording of discharges, storm factors, levels of lakes and groundwater levels). The numerical model is presently under calibration. Preliminary results indicate a measure of the effectiveness of numerical simulations. (See also W89-11016) (Author's abstract)
W89-11020

4C. Effects On Water Of Man's Non-Water Activities

ECOLOGICAL STATUS OF THE SEDIMENT COMMUNITIES OF CASTRIES HARBOUR, ST LUCIA, WEST INDIES,
Caribbean Environmental Health Inst., Castries (St. Lucia).
For primary bibliographic entry see Field 5C.
W89-10662

NEW HORIZON FOR WATER QUALITY IN JAPAN,
Water Pollution Control Federation, Alexandria, VA.
L. A. Preston.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 578-583, May 1989. 4 ref.

Descriptors: *Industrial development, *Urbanization, *Water pollution control, *Japan, *Water quality, *Land reclamation, *Water pollution, *Conservation, *Forest depletion, *Farmland depletion, Water resources development, Public education, Harbors, Seashores, Waste treatment, Wastewater treatment.

The intense land reclamation for industry and urban development, and the use of manufacturing processes without appropriate regulatory statutes, have caused rapid deterioration of forests, farmland, rivers, and coastal waters in Japan. Chemical discharges to coastal areas have created serious health problems, and changes in national land use have threatened the quality of water areas in both urban and rural areas, so that waste treatment and disposal have become critical issues. A consequence of Japan's rapid economic expansion during the years 1965-1975 was the disappearance of over 90% of the forested areas surrounding the major urban areas. The depletion of farmland has been even more severe, with 20% of the 15% total available farmland lost to development. Another major area of concern is the loss of inner harbors and seashores to development. The government has actively pursued conservation programs and public education as to the cause and effects of environmental pollution, and efforts have been made to protect plant and animal species in danger of extinction. An intensive 5-year program to expend and improve Japan's sewerage systems was initiated in 1986. This program has focused mainly on promoting environmental pollution control programs, total pollutant loading controls, and conservation of water quality in lakes and reservoirs. Specific plans have been developed in order to ensure the quality of Japan's future water resources: (1) establish stricter limits on effluents discharged from industrial and small-scale plants; (2) improve and extend pollution prevention facilities; (3) promote more treatment of household effluents; (4) establish water purification measures; (5) institute urban development guidelines; (6) implement regulations for chemical contamination. (Sand-PTT)
W89-10692

SOURCES OF ATMOSPHERIC METHANE IN THE SOUTH FLORIDA ENVIRONMENT,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 5B.
W89-10729

EVALUATING CUMULATIVE EFFECTS ON WETLAND FUNCTIONS: A CONCEPTUAL OVERVIEW AND GENERIC FRAMEWORK,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 6G.
W89-10770

CONCEPTUAL FRAMEWORK FOR ASSESSING CUMULATIVE IMPACTS ON THE HYDROLOGY OF NONTIDAL WETLANDS,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W89-10772

EVALUATING CUMULATIVE EFFECTS OF DISTURBANCE ON THE HYDROLOGIC FUNCTION OF BOGS, FENS, AND MIRES,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 6G.
W89-10773

EVALUATING THE CUMULATIVE EFFECTS OF ALTERATION ON NEW ENGLAND WETLANDS,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 6G.
W89-10774

CUMULATIVE IMPACTS ON WATER QUALITY FUNCTIONS OF WETLANDS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W89-10775

STRATEGIES FOR ASSESSING THE CUMULATIVE EFFECTS OF WETLAND ALTERATION ON WATER QUALITY,
East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W89-10776

IMPACTS OF FRESHWATER WETLANDS ON WATER QUALITY: A LANDSCAPE PERSPECTIVE,
Smithsonian Environmental Research Center, Edgewater, MD.
For primary bibliographic entry see Field 6G.
W89-10777

NATURE OF CUMULATIVE IMPACTS ON BIOTIC DIVERSITY OF WETLAND VERTEBRATES,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
For primary bibliographic entry see Field 6G.
W89-10778

ISSUES AND APPROACHES IN ASSESSING CUMULATIVE IMPACTS ON WATERBIRD HABITAT IN WETLANDS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 6G.
W89-10779

SOME THOUGHTS ON USING A LANDSCAPE FRAMEWORK TO ADDRESS CUMULATIVE IMPACTS ON WETLAND FOOD CHAIN SUPPORT,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 6G.
W89-10780

REGULATORY CONTEXT FOR CUMULATIVE IMPACT RESEARCH,
Dynamac Corp., Rockville, MD.
For primary bibliographic entry see Field 6G.
W89-10781

EVALUATION PARADIGM FOR CUMULATIVE IMPACT ANALYSIS,
Institute for Water Resources (Army), Fort Belvoir, VA.
For primary bibliographic entry see Field 6G.
W89-10782

DEVELOPING THE SCIENTIFIC BASIS FOR ASSESSING CUMULATIVE EFFECTS OF WETLAND LOSS AND DEGRADATION ON LANDSCAPE FUNCTIONS: STATUS, PERSPECTIVES, AND PROSPECTS,
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
For primary bibliographic entry see Field 6G.
W89-10783

COPPER IN THE FLY RIVER SYSTEM (PAPUA NEW GUINEA) AS INFLUENCED BY DISCHARGES OF MINE RESIDUE: OVERVIEW OF THE STUDY AND PRELIMINARY FINDINGS,
Institute for Soil Fertility, Haren (Netherlands).
For primary bibliographic entry see Field 5B.
W89-10832

SEDIMENT ACCUMULATION AND ITS EFFECTS ON A MISSISSIPPI RIVER OXBOW LAKE,
Agricultural Research Service, Oxford, MS.
For primary bibliographic entry see Field 2J.
W89-10841

PEAT DEPOSIT WATER QUALITY IN LAKE ISTOKPOGA, FLORIDA, U.S.A.,
Seminole Electric Cooperative, Inc., Tampa, FL.
For primary bibliographic entry see Field 2H.
W89-10842

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

BARNACLES AND MUSSELS AS BIOMONITORS OF TRACE ELEMENTS: A COMPARATIVE STUDY,
Hong Kong Environmental Protection Dept.
D. J. H. Phillips, and P. S. Rainbow.
Marine Ecology Progress Series MESEDT, Vol. 49, No. 1/2, p 83-93, November 10, 1988. 6 fig, 6 tab, 26 ref.

Descriptors: *Path of pollutants, *Trace elements, *Barnacles, *Mussels, *Bioaccumulation, Bioindicators, Cadmium, Chromium, Copper, Lead, Zinc, Comparison studies, Hong Kong.

Concentrations of five trace elements (cadmium, chromium, copper, lead and zinc) in three species of barnacle and the mussel Perna viridis were determined for up to 18 sites in Hong Kong coastal waters. Although each species accumulated differing absolute amounts of metals, qualitative agreement between contamination profiles exhibited by the four species for all elements other than cadmium was excellent. This was the case even for zinc, which is partially regulated by P. viridis. The relative bioavailabilities of metals other than cadmium to each of the four species at the sites studied are similar for the barnacle species and the mussel, and a consistent pattern of environmental contamination emerges from these data. By contrast, the bioavailability of cadmium appears to differ between each species; this may be at least partly due to the lack of a marked gradient in cadmium contamination of Hong Kong waters, as shown by previous studies and confirmed here. The differences between the species in trace metal accumulation are discussed, particularly as they relate to the use of barnacles and mussels as biomonitors of aquatic contamination. It is suggested that these species should be further employed in subtropical and tropical nations to establish present levels of contamination and monitor future trends. (Author's abstract)
W89-10538

BIOASSAY METHODS FOR EVALUATING THE TOXICITY OF HEAVY METALS, BIOCIDES AND SEWAGE EFFLUENT USING MICROSCOPIC STAGES OF GIANT KELP MACROCYSTIS PYRIFERA (AGARDH): A PRELIMINARY REPORT,
California Univ., Santa Cruz. Inst. of Marine Sciences.

B. S. Anderson, and J. W. Hunt.
Marine Environmental Research MERSDW, Vol. 26, No. 2, p 113-134, 1988. 6 fig, 2 tab, 43 ref. EPA cooperative agreement C-060000-23-0 and state board agreement no. 7-120-250-0.

Descriptors: *Bioindicators, *Kelps, *Toxicity, *Municipal wastewater, *Bioassay, *Heavy metals, Zinc sulfate, Sodium pentachlorophenate, Reproduction, Life history studies.

Methods for using early life stages of giant kelp Macrocystis pyrifera in toxicity tests intended for evaluating the toxicity of municipal sewage effluents are given. Included are methods for both a short-term (48 hour) toxicity test, and a long-term (16-day) toxicity test. Preliminary results of experiments with zinc sulfate, sodium pentachlorophenate, and a primary-treated sewage effluent showed that early life stages of Macrocyctis have a variable sensitivity to these toxicants. No Observed Effect Concentrations (NOECs) for effects of zinc sulfate on germination of Macrocystis zoospores ranged from 1730 microg/L to 5500 microg/L in three separate 48-h experiments. The NOECs for zinc effects on sporophyte production by Macrocystis was 1070 microg/L in a 16-day experiment. The fungicide and herbicide sodium pentachlorophenate significantly inhibited Macrocystis zoospore germination, and gametophyte reproduction at concentrations of 32 microg/L and greater (NOEC < 32 microg/L for both tests), and was more toxic to kelp than zinc. Primary-treated-sewage effluent significantly inhibited zoospore germination at concentrations greater than 1% effluent (NOEC = 0.56% effluent). The results of these preliminary experiments indicate that early life stages of Macrocystis pyrifera are amenable to evaluating the toxicity of a variety of toxicants, including sewage effluents, and that Macrocystis has a variable sensitivity to toxicants depending on the nature of toxicant and the endpoint being tested. (Author's abstract)
W89-10548

IMPROVED INTERLABORATORY COMPARISONS OF POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE SEDIMENT,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
W. D. MacLeod, A. J. Friedman, and D. W. Brown.
Marine Environmental Research MERSDW, Vol. 26, No. 3, p 209-221, 1988. 2 fig, 4 tab, 11 ref.

Descriptors: *Quality assurance, *Water analysis, *Pollutant identification, *Sediments, *Marine environment, *Hydrocarbons, *Laboratories, Comparison studies, Quality control, Testing procedures.

Interlaboratory precision in the analyses for polycyclic aromatic hydrocarbons (PAHs) in samples from the marine environment has improved substantially over the past decade. Early interlaboratory comparisons of analyses for PAHs in reference sediment showed variations in the data by as much as a factor of 10 among established laboratories. During this six-year study, such disparities progressively decreased through better and more uniform analytical procedures. In the latest intercomparison, the range of interlaboratory relative standard deviations (RSDs) improved better than twofold to 15-36% for 18 PAHs in a natural sediment prepared as a reference material. The improvement is attributed to: (1) use of a specific, improved extraction and cleanup procedure, (2) use of calibration and internal standards from common pre-analyzed supplies, and (3) preparation and use of a detailed standard methods manual. The results open the way to the establishment of statistically sound quality control programs among the participating laboratories and more rigorous monitoring of the marine environment. (Author's abstract)
W89-10551

HEAVY METAL ANALYSIS IN HEMIDACTYLUS MABOUIA (GECKONIDAE) AS A METHOD TO CLASSIFY URBAN ENVIRONMENTAL QUALITY (SCHWERMETALLANALYSEN IN HEMIDACTYLUS MABOUIA (GECKONIDAE) ALS METHODE ZUR BEWERTUNG DER UMWELGUTE VON STADTEN),
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
J. Schmidt.
Amazoniana, Vol. 9, No. 1, p 35-42, December 1984. 2 fig, 4 tab, 5 ref. English summary.

Descriptors: *Heavy metals, *Bioindicators, *Environmental quality, *Pollutant identification, *Food chains, *Urban areas, *Lizards, Hemidactylus, Brazil, Lead, Cadmium, Zinc.

The results of the Ecology Program of the GTZ (German Agency for Technical Cooperation) in Porte Alegre, Brazil are presented. The suitability of the lizard Hemidactylus mabouia as an indicator species of an environmental quality zonation in the urban area was evaluated. Different accumulation levels of the heavy metals Pb, Cd and Zn in this species and in other components of the food chain were analyzed. Considering the suitability of this species as a bioindicator, more studies utilizing its potential should be carried out in order to assess the presence of pollutants in Brazilian urban ecosystems. (Author's abstract)
W89-10593

PHOTO-OXIDATION OF DISSOLVED ORGANIC MATTER FOR TRACE METAL ANALYSIS,
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 7B.
W89-10636

HEAVY METAL UPTAKE BY PLANKTON AND OTHER SESTON PARTICLES,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 5B.
W89-10638

LEAD ISOTOPES AS SEEPAGE INDICATORS AROUND A URANIUM TAILINGS DAM,
Division of Exploration Geoscience, P.O. Box 136, North Ryde, NSW 2113, Australia.
For primary bibliographic entry see Field 5B.
W89-10654

CHIRONOMID MIDGES AS INDICATORS OF ORGANIC POLLUTION IN THE SCIOTO RIVER BASIN, OHIO,
Ohio Univ., Athens. Dept. of Zoological and Biomedical Sciences.
J. G. Rae.
Ohio Journal of Science OJSCA9, Vol. 89, No. 1, p 5-9, March 1989. 3 fig, 1 tab, 31 ref. Francis Marion College Grant.

Descriptors: *Water pollution effects, *Aquatic insects, *Midges, *Bioindicators, *Water quality, *Pollutant identification, *Environmental tracers, Chemical analysis, Benthic fauna, Alkalinity, Hardness, Enrichment, Acidic water, Organic wastes, Ohio, Agricultural runoff.

Faunal and water chemistry data were derived from an extensive survey of streams in the Scioto River basin, Ohio, and analyzed to determine biotic indicators of water quality. The data for 11 water chemistry characteristics were simplified by means of factor analysis, which generated three new axes (alkalinity-hardness, enrichment (sewage), agricultural runoff) that explained 71.5% of the total variance. The distributions of 14 common larval chironomid genera were then placed upon these new axes, based on coordinates generated for each sample site. These genera were found to occupy significantly different environments. Heuristic analysis of the data identified five groups of genera, each indicating particular water quality conditions: (1) Stictochironomus--hard, alkaline unpolluted water; (2) Pentaneura, Cricotopus, and Tanytarsus--sewage enriched water; (3) Procladius and Dicrotendipes--high agricultural runoff; (4) Ablabesmia and Tribelos--general organic pollution, soft acid water; and (5) Micropsectra, Microtendipes, Glyptotendipes, Chironomus, Polypedilum, and Cryptochironomus--facultative genera. (Author's abstract)
W89-10666

SHOULD WE USE A WELL FOOT (SEDIMENT TRAP) IN MONITORING WELLS,
For primary bibliographic entry see Field 8G.
W89-10676

APPLICATIONS OF DUAL-WALL REVERSE-CIRCULATION DRILLING IN GROUND WATER EXPLORATION AND MONITORING,
Hart Environmental Management Corp., Irvine, CA.
For primary bibliographic entry see Field 7B.
W89-10677

ORGANIZATION AND OPERATION OF THE SAVANNAH RIVER PLANT'S GROUNDWATER MONITORING PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7A.
W89-10678

TRACER TEST FOR DETECTING CROSS CONTAMINATION ALONG A MONITORING WELL COLUMN,
EBASCO Services, Inc., Chicago, IL.
D. Meiri.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 78-81, Spring 1989. 5 fig, 1 tab, 6 ref.

Descriptors: *Observation wells, *Tracers, *Path of pollutants, *Water quality, *Groundwater pollution, *Monitoring, Wells, Aquifers, Sodium bromide, Contamination, Aquifer systems.

A tracer test was used to evaluate whether cross contamination exists along a monitoring well completed through a shallow groundwater system in fractured clay and screened in a sand and gravel aquifer. The fractured clay is separated from the sand and gravel deposit by a layer of highly plastic unfractured clay. A natural vertical downward hydraulic gradient of approximately 0.5 exists between the shallow system and the sand and gravel aquifer. Groundwater contamination was detected in an adjacent monitoring well screened in the fractured clay and in the monitoring well screened in the sand and gravel deposit. No groundwater contamination was apparent in an intermediate well screened in the unfractured clay layer. A tracer of sodium bromide was injected into a shallow boring near the monitoring wells. The tracer was detected in the monitoring well in the sand and gravel aquifer after 3-7 days. The bromide concentration continued to increase in this well with time while the concentration in the shallow boring declined. This trend of tracer concentration indicates the tracer has in fact migrated downward and possibly traveled along the well column. (Author's abstract)
W89-10679

LIMITATIONS OF MONITORING WELLS FOR THE DETECTION AND QUANTIFICATION OF PETROLEUM PRODUCTS IN SOILS AND AQUIFERS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 7A.
W89-10681

EQUIPMENT DECONTAMINATION PROCEDURES FOR GROUND WATER AND VADOSE ZONE MONITORING PROGRAMS: STATUS AND PROSPECTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. T . Mickam, R. Bellandi, and E. C. Tifft.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 100-121, Spring 1989. 4 fig, 3 tab, 14 ref. Append.

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

Descriptors: *Quality control, *Water analysis, *Sample preservation, *Groundwater quality, *Sampling, *Groundwater pollution, *Vadose water, *Monitoring, *Hazardous wastes, *Decontamination, Standards, Regulations, Drilling equipment, Water sampling, Chemical analysis.

A major portion of the work effort and, therefore, the money spent during investigations of ground water and the vadose zone at hazardous waste sites is associated with collecting chemical data. To that end, effective decontamination of reusable drilling equipment, sampling apparatus, and tools is critical to the credibility of chemical data. Samples representative of the site under study are essential. Several state and federal regulatory agencies have established guidelines for procedures that should be considered when developing decontamination protocols. These agencies were contacted and asked to furnish copies of their decontamination guidelines. The information was reviewed, and comparisons were made to assess the status of standards of decontamination practices for ground water and vadose zone monitoring programs at hazardous waste sites. Summaries of a variety of decontamination protocols were prepared. From this review, it is apparent that there is a need to standardize, to the extent possible, procedures for the field decontamination of equipment. Two ASTM Subcommittees, D18.14 on Waste Management and D18.21 on Ground Water and Vadose Zone Monitoring, are currently working on developing standards for decontamination procedures. They, in cooperation with state and federal agencies and other interested technical groups, will develop standards for the field decontamination equipment used to study ground water and the vadose zone. (Author's abstract)
W89-10682

USE OF ON-SITE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY TO EVALUATE THE MAGNITUDE AND EXTENT OF ORGANIC CONTAMINANTS IN AQUIFERS,
Geological Survey, Menlo Park, CA.
D. F. Goerlitz, and B. J. Franks.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 122-129, Spring 1989. 2 fig, 5 tab, 16 ref.

Descriptors: *Chromatography, *Groundwater quality, *Water analysis, *Groundwater pollution, *Monitoring, *Aquifers, *High performance liquid chromatography, *Pollutant identification, On-site tests, Water sampling, Sample preservation.

Scientists engaged in the appraisal of groundwater contaminated by organic substances are faced with the problem of difficult sample collection and timely chemical analysis. High-performance liquid chromatography was evaluated for on-site determination of specific organic contaminants in groundwater samples and was used at three study sites. Organic solutes were determined directly in water samples, with little or no preparation, and usually in less than an hour after collection. This information improved sampling efficiency and was useful in screening for subsequent laboratory analysis. On two occasions, on-site analysis revealed that samples were undergoing rapid change, with major solutes being upgraded and alteration products being formed. In addition to sample stability, this technique proved valuable for monitoring other sampling factors such as compositional changes with respect to pumping, filtration, and cross contamination. (Author's abstract)
W89-10683

EVALUATION OF THE ADMINISTRATIVE UTILITY OF INFORMATION GENERATORS IN MANAGING TOXIC SUBSTANCES: THE CASE OF THE QSAR INFORMATION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Crowley, J.-L. Sasseville, and P. Couture.
Journal of Environmental Management JEVMAW, Vol. 28, No. 2, p 93-107, March 1989. 1 fig, 2 tab, 57 ref.

Descriptors: *Hazardous materials, *Information systems, *Administrative agencies, *Environmental policy, *Waste management, Legislation, Structure-activity relationships, Risk assessment.

One of the determinant factors in the effectiveness and efficiency of the public management of toxic substances is the gathering, selection and analysis of adequate information. The general lack of information on the effects or fate of most of the thousands of potentially toxic chemicals, and the high cost of producing data in the laboratory or in the field, have stimulated the development of models that can generate the missing information at a low cost. The administrative utility of these information generators is determined by (1) their predictive ability and (2) the justification needed for regulatory action. While the former is based on scientific and technical considerations, the latter is defined by the legal framework within which the regulatory agencies must operate. This article discusses the case of the QSAR (Quantitative Structure-Activity Relationships) information system, and how its predictions on the toxicity of chemicals to aquatic organisms can be helpful in the implementation of the Canadian Environmental Contaminants Act. The Act imposes a heavy burden of proof on the regulatory agencies involved, and it is unlikely that QSAR predictions would be acceptable as direct evidence of a chemical's toxicity. However, the QSAR information system can be used as a screening tool for identifying those high-risk chemicals for which the agencies may gather more costly direct evidence. (Author's abstract)
W89-10699

QUANTITATIVE ANALYSIS OF SOLUBILIZED METHANE IN REFUSE LEACHATE,
University of Strathclyde, Glasgow (Scotland). Dept. of Bioscience and Biotechnology.
I. A. Watson-Craik, and E. Senior.
Letters in Applied Microbiology LAMIE7, Vol. 8, No. 2, p 49-53, February 1989. 3 fig, 8 ref.

Descriptors: *Chemical analysis, *Pollutant identification, *Methane, *Landfills, *Leachates, *Wastewater disposal, Gas chromatography, Methane bacteria, Phenols, Quantitative analysis.

A rapid, simple method was developed for the quantitative gas chromatographic determination of methane release from continuously perfused, passively vented, heterogeneous laboratory landfill models. The method is applied to an examination of the effects of the co-disposal of a model phenolic wastewater with fermenting refuse at discrete dilution rates in a multi-stage refuse column array. Although determination of methane release rates by direct headspace analysis is problematic in model systems such as the multi-stage array, in which the generated gas is passively vented through the effluent reservoir and excess pressures released through gas traps attached to each column, a statistically significant correlation between dissolved and gas phase methane concentrations permits the estimation of methane release rates from rapid direct gas phase analyses. (Sand-PTT)
W89-10703

ECOLOGY OF FRESHWATER NEMATODES: A REVIEW (A BADAN NAD EKOLOGIA NICIENI W WODACH SLODKICH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
K. Prejs.
Wiadomosci Ekologiczne WEKLAF, Vol. 34, No. 1, p 3-29, 1988. 1 fig, 5 tab, 134 ref. English summary.

Descriptors: *Literature review, *Nematodes, *Ecological distribution, *Bioindicators, *Eutrophic lakes, *Lakes, *Trophic level, Benthic environment, Plant tissues, Root zone, Oligotrophic lakes, Littoral environment, Species diversity, Adaptation, Bacteria, Detritus, Algae, Predation.

A review of the literature on the ecology of freshwater nematodes discusses the following topics: (1) benthic nematodes, (2) periphytic nematodes, (3) nematodes of the root region and those penetrating the plant tissue, (4) nematodes in polluted environments, (5) trophic classification of nematodes. The data for various water bodies show that among benthic nematodes the most frequent dominants are Tobrilus gracilis and Monhystera paludicola. Maximal numbers are recorded in the littoral of eutrophic lakes and in the profundal of oligotrophic lakes. With increasing eutrophication of lakes the number of species and their diversity decrease. Chromadoridae are the most characteristic for periphyton. They are well adapted to life in an environment exposed to wave action as they can attach themselves quickly to the substrate. The root region and underground parts of aquatic macrophytes are colonized by a specific assemblage of nematodes; plant tissues are inhabited mainly by Tylenchida and Dorylaimida. Tissue damage has been found to result from nematode activity. Nematodes can be good indicators of pollution of aquatic environments. With the increasing degree of pollution in rivers, the species diversity of nematodes decreases. On the basis of trophic classification of nematodes and information on the feeding habits of particular species, five trophic groups are distinguished: (1) bacterial and detritus feeders, (2) algae feeders, (3) obligate plant feeders, (4) predators, and (5) miscellaneous feeders (omnivorous). (Author's abstract)
W89-10802

CONVENIENT TEST METHOD FOR PHOTOCHEMICAL TRANSFORMATION OF POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Swedish Environmental Research Inst., Stockholm.
A. Svenson, and H. Bjorndal.
Chemosphere CMSHAF, Vol. 17, No. 12, p 2397-2405, 1988. 3 fig, 1 tab, 13 ref.

Descriptors: *Photolysis, *Testing procedures, *Chemical degradation, *Aquatic environment, *Fate of pollutants, *Irradiation, Water pollution, Organic compounds, Phenols, Chlorinated hydrocarbons, Light quality.

A test method, based on a modified Xenotest 1200 has been proved to be convenient for determination of the rate of photolytical degradation and by that it can make a valuable contribution to the evaluation of environmental stability of organic compounds. The test method was applied to testing of photochemical degradation of organic chemicals in aquatic media. Solutions of six chlorinated phenolic substances, 8-quinolinol and 9,10-anthraquinone were illuminated with filtered light, simulating daylight at controlled conditions. Quantum yields of photochemical degradation and half lifetimes (of conversion) were calculated using a sun spectrum at 60 deg N. Chlorophenols absorbing light at 295-350 nm were converted and theoretical half lifetimes of 0.75-2.6 hours were obtained. The photochemical conversion of 8-quinolinol was slow. Anthraquinone was studied in ethanol/water and the degradation corresponded to a half lifetime of 2.8 hours. (Author's abstract)
W89-10812

CULTURE TECHNIQUES FOR THREE FRESHWATER MACROINVERTEBRATE SPECIES AND THEIR USE IN TOXICITY TESTS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
C. P. McCahon, and D. Pascoe.
Chemosphere CMSHAF, Vol. 17, No. 12, p 2471-2480, 1988. 1 fig, 2 tab, 43 ref.

Descriptors: *Macroinvertebrates, *Culturing techniques, *Bioassay, *Toxicity, Daphnia, Crustaceans, United Kingdom, Midges, Gammarus, Amphipods, Isopods.

Only one freshwater invertebrate species (Daphnia magna) is widely used in routine toxicity tests in the United Kingdom. Methods are described for the continuous laboratory culture of three European macroinvertebrate species: the dipteran Chironomus riparius, the amphipod Gammarus pulex, and the isopod Asellus aquaticus. Their use as test species to assess both acute and chronic toxicity responses is discussed. The three species are widely distributed in Europe and are readily amenable to laboratory culture, using simple, inexpen-

sive techniques which require minimal space and maintenance. All three can be cultured from egg to egg and thus several genetically similar generations can be produced from a single stock population if required, or alternatively field-collected animals can be introduced to the breeding population to ensure genetic diversity and that cultures remain representative of the natural population. Large numbers of offspring are produced and are available throughout the year at any required developmental stage. The three species display a range of sensitivity to a variety of pollutants and are suitable for use in both acute and chronic toxicity tests to assess pollutant effects either in the water column or when associated with sediments. As such, it is recommended that these three invertebrates be more widely employed as test organisms in the hazard evaluation process. (Doria-PTT)
W89-10813

NEW MICRO-DETECTION TUBE FOR CHOLINESTERASE INHIBITORS IN WATER,
National Univ. of Defense Technology, Changsha (China). Dept. of Applied Chemistry.
D. Tingfa, Z. Shiguang, and T. Mousheng.
Environmental Pollution ENPOEK, Vol. 57, No. 3, p 217-222, 1989. 1 fig, 4 ref.

Descriptors: *Wastewater analysis, *Chemical analysis, *Water analysis, *Organophosphorus pesticides, *Pollutant identification, *Pesticides, Wastewater, Nitrites, Bicarbonates, Disinfection, Oxidation, Chlorination, Water pollution.

A cheap and simple but very sensitive and specific detection tube was developed for the detection of cholinesterase-inhibiting compounds in natural and wastewater disinfected with chlorine-containing oxidants. After the oxidants have been quantitatively destroyed by a mixture of NaNO2 and NaHCO3, the horse-serum cholinesterase catalyzes the hydrolysis of the orange-red 2,6-dichloro-indophenyl acetate producing the blue 2,6-dichloroindophenol. The color transformation does not occur when the enzyme is inactivated by the cholinesterase-inhibiting compounds. By making use of a chemical heater, the detection tube can complete a check job at an environmental temperature as low as about 0 C in only 5 min. The plastic-made detection tube is composed of an inner tube for use in chemical reaction and an outer tube for use in chemical heating. DDVP can be detected at concentrations as low as 2 micrograms/ml when the sampled water volume is 0.5 ml. (Author's abstract)
W89-10823

SAMPLING STRATEGIES FOR WATER QUALITY MONITORING IN LAKES: THE EFFECT OF SAMPLING METHOD,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7A.
W89-10824

EVALUATION OF METAL CONCENTRATIONS IN BOTTLED WATERS AND THEIR HEALTH SIGNIFICANCE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
I. Alam, and M. Sadiq.
Environmental Technology Letters ETLEDB, Vol. 9, p 925-930, 1988. 2 tab, 18 ref.

Descriptors: *Bottled water, *Metals, *Public health, *Water analysis, Saudi Arabia, Acidity, Calcium, Sodium, Pollutant identification, Chemical analysis, Drinking water, Magnesium, Water quality, Standards.

Bottled water is commonly consumed in Saudi Arabia. Several brands are locally produced and others are imported. The objective of this study was to evaluate the quality, especially metal concentrations, of bottled waters marketed in Saudi Arabia. About 100 samples of nine commonly consumed bottled waters were collected from the supermarkets and analyzed for pH and concentrations of 18 metals using inductively coupled argon plasma. It was found that the concentrations of calcium and sodium in Taiba and Al-Shifta brands, and magnesium and sodium in Al-Rawabi brand were higher than the values claimed on their labels. The concentrations of calcium in Evian and magnesium in Al-Rawabi were higher that the desirable limits of these elements in drinking water. All other metals determined in this study were found below their permissible or desirable limits. (Author's abstract)
W89-10831

HEAVY METALS MONITORING BY THE PIXE TECHNIQUE IN THE COASTAL ZONE OF PORTUGAL,
Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). Dept. de Estudos de Impacte Industrial.
M. M. Costa, M. C. Peneda, and R. Leite.
Environmental Technology Letters ETLEDB, Vol. 9, p 941-944, 1988. 1 fig, 1 tab, 4 ref.

Descriptors: *Pollutant identification, *Heavy metals, *Monitoring, *Coastal waters, *Portugal, Water quality, Pulp wastes, Detection limits, Chromium, Iron, Nickel, Copper, Zinc, Arsenic, Molybdenum, Mercury, Lead.

Heavy metals assessment, for checking the sea water quality of the subtidal zone between Leirosa and Pedrogao, on the west coast of Portugal, over a 30 km length, was the main purpose of this study. Samples were irradiated in a Van de Graaff accelerator by a beam of protons. 30-minute counts were run on deionized water blanks together with the samples. Detection limits were obtained in the range of 0.2-20 micrograms/l for 150 ml of sample and 30 microC charge, but it will be necessary to measure lower values in the case of sea water analysis. Therefore, the technique will be improved by performing the work under dust-free conditions in a laminar flow cabinet and in a clean room. It is concluded that the technique is very suitable, because in one run it was possible to analyze about 30 elements and evaluate the metal charge in any water samples. The values obtained are higher than those in the literature for oceanic waters. (Author's abstract)
W89-10833

PROGRAMME TO IMPROVE THE QUALITY OF ANALYTICAL RESULTS IN THE ENVIRONMENTAL MONITORING OF ORGANOTIN COMPOUNDS,
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
L. Ebdon, S. Hill, and B. Griepink.
Environmental Technology Letters ETLEDB, Vol. 9, p 965-968, 1988. 1 tab, 13 ref.

Descriptors: *Organotins, *Pollutant identification, *Pesticides, *Quality control, *Monitoring, *Metal complexes, *Tin, Chemical analysis, Water analysis, Shellfish, Aquaculture, Europe, Oysters, Mollusks, Toxicity, Chromatography, Mass spectrometry, Water pollution effects, Sediments.

Considerable concern has been expressed regarding the environmental effects of organotin compounds, particularly the effects of tributyltin (TBT) compounds on mariculture and shellfish in general. This paper reports a program under the aegis of the Bureau of Community Reference (BCR) with the ultimate aim of producing a tributyltin certified reference material. Details are given of an inter-laboratory collaborative study currently underway among expert laboratories throughout the European Economic Community. Once the results of this preliminary collaborative study of aqueous solutions of inorganic and organotin are known, the next step is to extend the study to look at TBT levels in estuarine and near shore sediments. Two sediments will be sent out, one spiked with TBT, the other unspiked. A fine-grained sediment with the larger particles removed by sieving is to be provided, and ideally this should be spiked at two levels. The round after this is likely to be a real sample of sediment which will lead on to the certification of a sediment sample. (Author's abstract)
W89-10835

DETERMINATION OF THE LEVEL OF SOME HEAVY METALS IN AN AQUATIC ECOSYSTEM BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS,
Laboratorio Nacional de Engenharia e Tecnologia Industrial, Lisbon (Portugal). Dept. de Energia e Engenharia Nucleares.
M. C. Freitas, M. C. V. Carreiro, M. R. Reis, and E. Martinho.
Environmental Technology Letters ETLEDB, Vol. 9, p 969-976, 1988. 6 tab, 23 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chemical analysis, *Heavy metals, *Neutron activation analysis, *Water pollution, Portugal, Sediments, Fish, Macrophytes, Silver, Molybdenum.

In this work, 14 heavy metals have been determined in samples of water, sediments, aquatic macrophytes, and fishes from Fratel Dam in the Tejo River, Portugal using instrumental neutron activation analysis. The concentrations found in the first three compartments of the ecosystem do not differ by more than one order of magnitude from the reference values available in the literature; two orders of magnitude differences were found for silver and molybdenum for the whole fish, but the reference values concern only the fish muscle and both elements have an affinity to the gastrointestinal tract. In general, higher heavy metal concentrations were obtained in bank sediments than in sediments 3 m away from the bank. It should be stressed that these are preliminary results, covering only one season; nevertheless, the results obtained show that the heavy metal levels in the fresh water ecosystem under study are close to the reference values, which points to a normal situation at the Fratel Dam. (Author's abstract)
W89-10836

STUDY OF TOXIC COMPOUNDS IN RIVER BOTTOMS AT METROPOLITAN AREAS,
Indianapolis Public Works Dept., IN.
For primary bibliographic entry see Field 5B.
W89-10860

CHARACTERIZATION AND EVALUATION OF ENVIRONMENTAL HAZARDS IN A LARGE METROPOLITAN LANDFILL,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
W. V. Black, D. S. Kosson, and R. C. Ahlert.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 147-153, 1 fig, 4 tab, 19 ref.

Descriptors: *Pollutant identification, *Landfills, *Waste disposal, *New York, Chemical analysis, Hydrocarbons, Aromatic compounds, Benzene, Pyrenes, Fluoranthene, Phenanthrene, Organic compounds.

Fountain Avenue Landfill (FAL) is a 297-acre site located on the north shore of Jamaica Bay. FAL, Pennsylvania Avenue Landfill (PAL)(just west of FAL), Jamaica Bay and parts of the surrounding area make up the Gateway National Recreation Area. Fountain Avenue Landfill received waste from New York City for 25 years. It opened in late 1961, about the same time the Pennsylvania Avenue site was closed, and over the years received both municipal and commercial waste. A number of tests and surveys have been carried out on the air, water and sediments surrounding the two landfills. Samples were collected on four different occasions from various locations on the periphery of the fill, and were analyzed for polycyclic aromatic hydrocarbons (PAHs). Results from high performance liquid chromatography (HPLC) analysis identified a number of compounds, including: phenanthrene, fluoranthrene, and pyrene. Compounds of moderate carcinogenic activity were dibenzo(a,h)anthracene, benzo(g,h,i)perylene, benzo(k)fluoranthene, and benzo(b)fluoranthene. (See also W89-10858) (Lantz-PTT)
W89-10878

Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

EVALUATION OF LEACHATE MONITORING DATA FROM CO-DISPOSAL, HAZARDOUS, AND SANITARY WASTE DISPOSAL FACILITIES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
A. D. Levine, and L. R. Rear.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 173-183, 5 fig, 8 tab, 15 ref.

Descriptors: *Pollutant identification, *Hazardous wastes, *Waste disposal, *Leachates, Monitoring, Organic carbon, Hydrogen ion concentration, Metals, Halides, Landfills, Groundwater pollution, Surface water pollution.

Monitoring of hazardous wastes, landfill leachates, and groundwater and surface water contamination is a necessary component of hazardous wastes management, treatment, and cleanup programs. Because contaminants are measured in concentrations as low as parts per billion (ppb) or parts per trillion (ppt), the test methods must be quite sensitive. Indicator, or surrogate, parameters are used as screening tests to identify the presence of toxic compounds and determine the need for more extensive monitoring. Indicators of contamination include total organic carbon (TOC), total organic halide (TOX), specific conductivity, and pH. Hazardous leachates had the highest levels of total dissolved solids, specific conductivity, ammonia, and sulfate, while sanitary landfill leachates had the highest levels of suspended solids and biochemical oxygen demand (BOD). The codisposal sites had the highest levels of chloride and were intermediate between the sanitary and the hazardous leachates for the other measured parameters. The levels of oil and grease, pH, COD, TOC and TOX were not significantly different among the facility types. Metals were analyzed routinely at all disposal facilities; however, in many cases, the reported values were at or below the method detection limits. The number of organic compounds analyzed at the waste disposal facilities varied considerably, but fewer than 15% of the measured organic compounds were detected. The ability of the TOC and TOX measurements to detect the presence of organic contaminants was evaluated by comparing calculated values of TOC and TOX to the detected concentrations of organic contaminants. Of the two parameters, TOX appears to be more closely related to measured levels of regulated contaminants; however, TOX is not a reliable predictor of halogenated organic contaminants. (See also W89-10858) (Lantz-PTT)
W89-10881

NOVEL APPROACH TO SIMPLIFIED RESPIROMETRIC OXYGEN DEMAND DETERMINATIONS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-10909

PRETREATMENT LIMITS FOR FATS, OIL AND GREASE,
Howard, Needles, Tammen, and Bergendoff, Milwaukee, WI.
For primary bibliographic entry see Field 5D.
W89-10939

WATER QUALITY OF THE FRENCH BROAD RIVER, NORTH CAROLINA--AN ANALYSIS OF DATA COLLECTED AT MARSHALL, 1958-77,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-10945

WATER QUALITY OF THE NEUSE RIVER, NORTH CAROLINA-VARIABILITY, POLLUTION LOADS, AND LONG-TERM TRENDS,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-10946

ESSENTIAL OF BIOTECHNOLOGY,
Versar, Inc., Springfield, VA.
For primary bibliographic entry see Field 7B.
W89-10960

APPLICATIONS OF BIOTECHNOLOGY,
Versar, Inc., Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-10962

BIOLOGICAL INDICATORS OF FRESHWATER POLLUTION AND ENVIRONMENTAL MANAGEMENT,
Nature Conservancy Council, Peterborough (England).
J. M. Hellawell.
Elsevier Applied Science Publishers, New York. 1986. 546 p.

Descriptors: *Environmental control, *Water pollution control, *Bioindicators, *Monitoring, *Water pollution effects, Biological studies, Ecological effects, Ecosystems, Toxicity, Bioaccumulation, Fate of pollutants, Literature review.

This text reviews the current knowledge of the responses of individual organisms and communities to environmental changes and their use as biological indicators of environmental quality in assessing the intensity of pollution and other disturbances. It discusses the use of biological indicators for encouraging the ecologically sensitive management of freshwaters in the face of the conflicting demands of today's society. The first three chapters define the basic principles of hydrobiology and introduce the relevant fundamental ecological principles of community organization, the factors which affect communitites, bioaccumulation of poisons, the toxicological properties of pollutants and the effect of engineering operations and other environmental perturbations on different hierarchies of biological organizations. The following chapters critically review the effects of environmental stress including physical disturbance, nutrient enrichment and the entry of toxic materials. Data, in the form of tables and graphs for ready comparison, provide a valuable work of reference for the specialist. Laboratory evaluation of pollutants, methods of field assessment and the use of biological surveillance in environmental management are explained and discussed. The book also contains a selected but extensive bibliography of approximately 1000 references. (Author's abstract)
W89-10986

REPORT OF THE NATIONAL WORKSHOP ON INSTREAM BIOLOGICAL MONITORING AND CRITERIA.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-245964. Price codes: A03 in paper copy, A01 in microfiche. Held in Lincolnwood, Illinois, December 2-4, 1987. No. EPA/600/9-88/016, August 1988. 34p, 1 fig, 1 tab, 18 ref, 3 append.

Descriptors: *Stream biota, *Environmental quality, *Water quality control, *Monitoring, Conferences, Regulations, Water pollution control, Aquatic environment, Legislation.

The purpose of the workshop was to assess the role of biocriteria and information generated by ambient biological sampling in the State and Federal surface water programs. This workshop was convened, in part, in response to the Water Quality Act (WQA) of 1987, Sec. 303(c)(2)(B), which requires the US Environmental Protection Agency to develop criteria based on biological assessment methods when numerical criteria are not established for the priority pollutants listed in Section 307(a) of the Clean Water Act; and in part to bring together a nationwide group of aquatic biologists and water resource managers who are presently developing and/or applying biocriteria to protect or restore the Biological integrity of the nation's waters. The recommendations of the workshop are summarized to illustrate to regulatory agencies, that biosurveys are an important monitoring and evaluation tool, and that biocriteria can provide a measure of the attainment of the interim goals of Sec. 101(a)(2) of the WQA. (Author's abstract)
W89-10987

ELECTROCHEMICAL STUDIES OF THE TIN(IV)-PYROCATECHOL VIOLET SYSTEM,
Naval Weapons Center, China Lake, CA.
D. A. Fine.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 451. Price codes: A03 in paper copy, A01 in microfiche. Report No. NWC TP 6839, October 1987. 24p, 13 fig, 4 tab, 12 ref.

Descriptors: *Water analysis, *Organotins, *Pollutant identification, *Chemical analysis, *Electrochemistry, *Tin, Pyrocatechol violet, Electrodes, Voltammetry, Liquid chromatography.

In an effort to develop simpler methods for the analysis of natural waters for toxic organotin compounds, the electrochemical properties of pyrocatechol violet (PCV) and the complex formed by this reagent with tin(IV) (Sn(IV)), were studied. The reagent and the complex were found to show oxidative response to a glassy carbon electrode. Concentrations of tin as low as 200 parts per billion (ppb) were detectable by oxidative linear sweep-voltammetry. Because of the decrease in the height of a characteristic PCV peak upon addition of Sn(IV), formation of the complex was also detectable by liquid chromatography with electrochemical detection. Neither method proved responsive to organotin, although a response was observed upon conversion of organotin to inorganic Sn(IV). (Author's abstract)
W89-10988

BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN UNCONSOLIDATED SURFICIAL MATERIALS AT THE U.S. DEPARTMENT OF ENERGY KANSAS CITY FACILITY,
UNC Geotech, Grand Junction, CO.
H. L. Fleischhauer.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-010902. Price codes: A04 in paper copy, A01 in microfiche. Report No. DOE/ID--12584-20, February 1988. 92p, 18 fig, 16 tab, 41 ref, 2 append. DOE Contract DE-AC07-86ID12584.

Descriptors: *Baseline studies, *Unconsolidated aquifers, *Pollutant identification, *Groundwater pollution, *Path of pollutants, Geohydrology, Pollution load, Arsenic, Beryllium, Cadmium, Chromium, Copper, Lead, Manganese, Mercury, Nickel, Zinc, Soil contamination, Geochemistry, Heavy metals.

A comprehensive geohydrologic site characterization is being conducted at the U.S. Department of Energy Manufacturing Facility in Kansas City, Missouri. The investigation was prompted initially by the discovery of volatile organic compounds in groundwater at the Tank Farm, an area where a number of underground storage tanks are located. The study has expanded to include other areas of the Facility such as landfills, surface impoundments, spill sites, and storm sewer systems. The site characterization seeks to: characterize the site geology; define and model the groundwater flow to predict migration of contaminants; and, define the extent of soil contamination in areas of known spills, leaks, and landfills. To date, 273 soil samples have been collected and more than 2000 analytical determinations have been performed for a suite of 10 elements: arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, and zinc. The initial estimates of background concentrations are updated in this report. It is commonly observed that an upper limit to the observed background concentrations exists. This upper limit is referred to as the threshold. Concentrations exceeding the threshold are not typical of background and may represent mineralization or environmental contamination. Background and threshold are identified by means of graphs of the cumu-

lative distribution of the sample data on probability paper. This technique was first applied by geochemists more than 20 years ago as a means of partitioning geochemical data sets into respective background and mineralized populations. The method is explained in detail in this report, and the results are presented in tabular form. (Lantz-PTT)
W89-10999

5B. Sources Of Pollution

1,2-DIBROMOETHANE AND CHLOROFORM IN THE RAINBOW TROUT (SALMO GAIRDNERI): STUDIES ON THE DISTRIBUTION OF NONVOLATILE AND IRREVERSIBLY BOUND METABOLITES,
Sveriges Lantbruksuniversitet, Uppsala. Dept. of Pharmacology and Toxicology.
P. O. Darnerud, B. Lund, E. B. Brittebo, and I. Brandt.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 26, No. 2, p 209-221, 1989. 4 fig, 2 tab, 19 ref.

Descriptors: *Dibromoethane, *Path of pollutants, *Bioaccumulation, *Chloroform, *Trout, *Fish, *Metabolites, *Radioactive tracers, *Carbon radioisotopes, Autoradiography, Tissue analysis, Fate of pollutants.

The disposition of metabolites from 14C-labeled 1,2 dibromoethane (DBE) and chloroform (CF) in juvenile rainbow trout was studied by autoradiography and quantitation of tissue radioactivity. Whole-body autoradiography of heated tissue sections showed a considerable level of nonvolatile metabolites of DBE and CF in the liver and certain areas of the body kidney. A lower level of metabolites appeared in the gills, intestinal mucosa, and olfactory rosettes in trouts exposed to DBE-containing and CF-containing water. Unlike previous studies in rodents, no specific uptake or binding of DBE or CF occurred in the surface epithelia of the upper alimentary tract. Microautoradiography and exhaustive tissue extraction confirmed a high irreversible binding of DBE metabolites in the liver and in a proximal tubular segment of the body kidney in fish exposed to DBE-containing water. A high level of radioactivity in the bile indicated fecal excretion of metabolites from both compounds. The results suggest that there is marked metabolism of DBE and CF in the liver and kidney, whereas the metabolism in the surface epithelia is low. The liver and kidney are proposed to be target organs of toxicity in fish. (Author's abstract)
W89-10532

COMBINED NEPHROTOXICITY OF METHYLMERCURY, LEAD AND CADMIUM IN PEKIN DUCKS: METALLOTHIONEIN, METAL INTERACTIONS, AND HISTOPATHOLOGY,
Ontario Veterinary Coll., Guelph.
P. V. P. Rao, S. A. Jordan, and M. K. Bhatnagar.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 26, No. 3, p 327-348, 1989. 8 fig, 3 tab, 78 ref.

Descriptors: *Toxicity, *Bioaccumulation, *Ducks, *Histology, *Pathology, *Lead, *Methylmercury, *Cadmium, Metallothionein, Zinc, Copper, Iron, Mercury, Path of pollutants, Heavy metals, Tissue analysis.

The metallothionein (MT) levels and accumulation of mercury, lead, and cadmium are described, along with their interaction with tissue zinc, copper and iron, and the histopathological changes in kidneys of ducks exposed to methylmercury chloride (MeHgCl), lead acetate (PbAc), and cadmium chloride (CdCl2), singly or in combination for 13 weeks. Forty-eight female Pekin ducks, divided into 8 groups of 6 birds each, were fed diets containing: (1) no added metals (control), (2) 8 mg MeHgCl/kg feed, (3) 80 mg PbAc/kg feed, (4) 80 mg CdCl2/kg feed, (5) 8 mg MeHgCl + 80 mg PbAc/kg feed, (6) 8 mg MeHgCl + 80 mg CdCl2/kg feed, (7) 80 mg PbAc + 80 mg CdCl2/kg feed, and (8) 8 mg MeHgCl + 80 mg PbAc + 80 mg CdCl2/kg feed. Cadmium (Cd), when administered alone or in combination, caused a 60-fold increase in kidney MT levels while methyl mercury (MeHg) or lead (Pb) administration caused a threefold increase in kidney MT levels. No significant changes in kidney MT levels were observed when metals were administered concurrently when compared with single-treatment groups. Residue analysis revealed accumulation of administered metals in kidney tissue. However, lead administration resulted in accumulation of small amounts of this element in kidney tissue. Simultaneous administration of MeHgCl and PbAc significantly increased the accumulation of lead in kidney when compared with PbAc-treated group. Cd, when administered alone or in combination, caused an increase in the levels of zinc and copper in kidney. Administration of MeHgCl or PbAc, either alone or in combination, caused increased iron levels in kidney while cadmium administration, either alone or in combination, caused decreased iron levels. Administration of cd, either alone or in combination, caused degenerative changes in kidney proximal tubes. The severity of degenerative lesions increased when Cd was simultaneously administered with other metals. These results indicate that combined administration of MeHg, Pb and Cd has no significant effect on kidney MT levels or on essential elements in kidney tissue when compared with single metal treatment groups. However, there appears to be an increase in the severity of histopathologic changes. (Author's abstract)
W89-10533

BARNACLES AND MUSSELS AS BIOMONITORS OF TRACE ELEMENTS: A COMPARATIVE STUDY,
Hong Kong Environmental Protection Dept.
For primary bibliographic entry see Field 5A.
W89-10538

INFLUENCE OF RUNOFF ON INTERTIDAL MUDFLAT BENTHIC COMMUNITIES,
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 5C.
W89-10545

SEASONAL PREDICTIONS FOR POLLUTANT SCAVENGING IN TWO COASTAL ENVIRONMENTS USING A MODEL CALIBRATION BASED UPON THORIUM SCAVENGING,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
K. R. Hinga.
Marine Environmental Research MERSDW, Vol. 26, No. 2, p 97-112, 1988. 5 fig, 55 ref.

Descriptors: *Tracers, *Fate of pollutants, *Path of pollutants, *Model studies, *Coastal waters, *Thorium, *Isotope studies, *Scavenging, Water pollution, Narragansett Bay, New York Bight, Seasonal variation.

A simple model is assembled to describe scavenging of potential pollutants in coastal environments. The model related the particle affinity (partition coefficient) of chemicals, particle dynamics, and water residence time to predict the amount of a chemical which would be scavenged relative to that which would escape the system. The model is calibrated using scavenging data for naturally occurring thorium isotopes. Seasonally dependent predictions of scavenging, as a function of the equilibrium partitioning coefficient (K sub d), are given for Narragansett Bay and New York Bight. Chemicals which are subject to extensive scavenging cannot be predicted from partition coefficients alone. The division between chemicals which will be primarily exported to offshore waters and those which will be primarily scavenged to the benthos can occur over a fairly narrow range within an order of magnitude of K sub d. The sharpness of the division is reduced where the fraction retained is much lower, as in winter Narragansett Bay conditions. The division between primarily scavenged, and primarily exported out of the system, occurs at different K sub d values in different conditions. From another perspective, a chemical that is effectively scavenged in one environment may be primarily exported from another environment. One might propose that the fraction of chemical which would be adsorbed to particles would be a good indicator of scavenging. It should also be noted that even though the water residence time in Narragansett Bay in summer is much less than in the New York Bight, the more active particle dynamics in the bay make it a more efficient scavenging environment. (Miller-PTT)
W89-10547

EFFECT OF SALINITY ON THE MICROBIAL MINERALIZATION OF TWO POLYACRYLIC AROMATIC HYDROCARBONS IN ESTUARINE SEDIMENTS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
R. P. Kerr, and D. G. Capone.
Marine Environmental Research MERSDW, Vol. 26, No. 3, p 181-198, 1988. 6 fig, 3 tab, 28 ref. Hudson River Foundation grant 14-83B-12 and 16-85B-6 and EPA grant R809475011.

Descriptors: *Fate of pollutants, *Path of pollutants, *Estuaries, *Sediments, *Salinity, *Mineralization, *Hydrocarbons, Coastal waters, Naphthalene, Anthracene, Hudson River estuary.

Sediments from the lower Hudson River estuary and two other coastal environments were examined experimentally for their ability to mineralize (convert to CO2) the polycyclic aromatic hydrocarbons (PAHs) naphthalene and anthracene over a range of salinities. Routine assays employed 1:1 (vol fresh sed:vol water) sediment slurries in order to overcome natural variability in mineralization rates among replicates. Mineralization rates were stimulated by about 2.5 fold, compared to unslurried controls, while the coefficient of variation fell from 13% to 3.5%. Rates of naphthalene mineralization in surface sediments from along the mainstem of the Hudson River ranged from 0.011 to 1.5 nmol/cu cm/day with no discernible trends along the estuarine gradient. For two stations examined experimentally, microbial assemblages appeared acclimated to broad salinity variations as imposed increases or decreases in salinity did not significantly alter rates of mineralization compared to controls. Sediments from two upstream marshes of the Hudson showed rates of naphthalene mineralization from 0.007 to 0.15 nmol/cu cm/day, while sediments from a third marsh in freshwater had high rates. For the two upstream marsh stations which rarely experienced salt intrusion, there was a substantial decrease in mineralization of naphthalene and anthracene with increasing salinity. Consistently high rates of naphthalene mineralization were observed in petroleum contaminated sediments from Port Jefferson Harbor (PJH) on the north shore of Long Island. PJH has a relatively constant salinity regime and imposed decreases in salinity effected decreases in rates of naphthalene and anthracene mineralization. The ability of salinity increases or decreases to affect the rate of model PAH mineralization appeared to be dependent on the natural variation in the salinity regime from which a sample was obtained. Data from all the environments studied indicated a strong positive correlation between PAH concentration and the rates of mineralization of naphthalene. Rates of PAH mineralization in all environments examined appear to be primarily controlled by the extent of pollutant loading and not by natural variations in the salinity regime. (Author's abstract)
W89-10550

INHIBITORY SUBSTRATE UTILIZATION BY STEADY-STATE BIOFILMS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
C. J. Gantzer.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 302-319, April 1989. 7 fig, 1 tab, 17 ref, append.

Descriptors: *Fate of pollutants, *Model studies, *Groundwater pollution, *Biodegradation, *Wastewater treatment, *Aquifers, *Biofilms, *Substrates, *Inhibition, *Biological wastewater treatment, *Microbial degradation, Films, Simula-

tion, Kinetics, Biodegradation, Model testing, Mathematical models, Numerical analysis, Simulation analysis, Mathematical models.

Because attached microbial growths are usually the predominant form of microbial biomass in soils and aquifers, a fundamental understanding of the effects of inhibitory substrates on biofilm activity is necessary to assess the possibility of microbial degradation of soils contaminated by organic compounds. Also, the relationship between inhibitory substrate concentration and biofilm activity can dictate the feasibility of using biofilm reactors to treat wastewaters containing high concentrations of inhibitory substances. Numerical simulations were performed that examined the utilization of inhibitory substrates by steady-state biofilms. Based on kinetic and energetic constraints, the growth of a monolayer of cells into a steady-state biofilm requires that substrate concentrations be between S sub min and S sub max. The continued exposure of a monolayer or dispersed cells to substrate concentrations less than S sub min or greater than S sub max will not lead to the development of a self-perpetuating biological treatment process. However, once developed, a steady-state biofilm can tolerate bulk substrate concentrations greater than S sub ma, because the inner layers of the biofilm are exposed to substrate concentrations less than S sub max due to mass transport resistance and substrate utilization in the outer layers of the biofilm. In such situations, maximal rates of substrate utilization and microbial growth occur in the middle or at the inner surface of the steady-state biofilm. The simulations also indicated that there are two sets of steady-state biofilms: one associated with S sub min (stable steady-state solutions) and the other associated with S sub max (unstable steady-state solutions). (Author's abstract)
W89-10575

PREDICTION MODELS OF VARIOUS POLLUTANTS IN THE RIVER TIGRIS AT BAGHDAD,
Baghdad Univ. (Iraq). Coll. of Engineering.
N. Al-Masri, S. A. Musa, and W. A. Ameer.
Journal of Environmental Science and Health (A) JESEDU, Vol. A24, No. 1, p 23-28, January 1989. 5 fig, 3 tab, 10 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Model studies, *Stream pollution, *Water pollution, *Iraq, *Mathematical models, Estimating equations, Model testing, Prediction, Chemical analysis, Regression analysis, River flow, Correlation analysis, Fluorides, Phosphates, Sulfates, Boron, Chlorides, Sodium.

The variation of pollutant concentrations in surface waters is of broad interest to scientists and researchers in the field of water pollution control. Models are useful in defining the nature of water systems and the relationship between their components. The degree of pollution, source of pollution and pollutant variation are among these components. This study evaluates the variations of several pollutants in the River Tigris at Baghdad from monthly sampling of eight stations, and utilizes different regression models. Some of the models used give an excellent estimate of pollutant variation in terms of distance, flowrate, and reference point concentration. Results indicate that the flowrate of the River Tigris is best correlated with fluoride, phosphate, sulfate, boron, and chloride concentrations by a third degree polynomial regression equation, while the best estimate of sodium concentration with river flowrate is given by the exponential regression equation. Models of other parameters measured were generally weak with low correlation coefficients. (Author's abstract)
W89-10588

HEAVY METALS IN MARINE ORGANISMS OF GERAS GULF, LESVOS, GREECE,
Thessaloniki Univ., Salonika (Greece). Lab. of Forensic Medicine and Toxicology.
H. Tsoukali-Papadopoulou, I. Kaniou-Gregoriades, P. Epivatianos, and J. A. Stratis.
Journal of Environmental Science and Health (A) JESEDU, Vol. A24, No. 1, p 39-47, January 1989. 4 fig, 2 tab, 14 ref.

Descriptors: *Path of pollutants, *Marine fisheries, *Greece, *Fish, *Shellfish, *Bioaccumulation, *Heavy metals, Path of pollutants, Copper, Iron, Chromium, Nickel, Mullet, Oysters, Clams.

The concentrations of copper, iron, chromium and nickel in fish and shellfish from Geras gulf, Lesvos island, Greece, were determined by atomic absorption spectrometry. Geras gulf is in the northeast Aegean sea and is the final receiver of tannery factory and olive oil refinery wastes. Four fish species, Mullus barbatus, Boops boops, Trachurus trachurus and Gobius sp., as well as two shellfish species, Ostrea edulis and venus sp. were caught during a one year period (12/85-11/86). These species were selected because they are the main marine organisms in the studied area and are heavily used as food. Mullus barbatus showed the highest Cu and Fe concentrations, although even they were in the range of normal concentrations reported in the literature. An analysis was made of the seasonal variation of metal concentrations in all species tested. Fish and shellfish showed Cu and Fe concentrations within normal values reported in the literature, and shellfish showed higher nickel concentrations when compared with fish. For those samples in which chromium was above the detection limit, the chromium concentration was high compared with normal values. (VerNooy-PTT)
W89-10589

PREDICTION OF THE SOLUBILITY OF HYDROCARBONS IN WATER USING UNIFAC,
Kuwait Univ., Safat. Dept. of Chemical Engineering.
T. A. Al-Sahhaf.
Journal of Environmental Science and Health (A) JESEDU, Vol. A24, No. 1, p 49-56, January 1989. 1 tab, 7 ref.

Descriptors: *Water pollution effects, *Water quality control, *Model studies, *Solubility, *Hydrocarbons, *Mathematical models, Estimating equations, Water pollution, Aliphatic hydrocarbons, Model testing, Organic compounds, Path of pollutants, Statistical analysis.

Prediction of the solubility of liquid hydrocarbons in water is essential for estimating the effect of such water contamination on aquatic life and devising appropriate methods for water cleanup. In this work, the application of the UNIFAC method with parameters obtained from liquid-liquid equilibria was evaluated for the water solubility of paraffins, cycloparaffins, olefins, diolefins, cycloolefins and aromatics. Calculated and experimental solubility values (in ppm) for 29 hydrocarbons are compared. The best results were obtained for the case of aromatics, with an average percent deviation of 4.3. The overall average percent deviation is 23%, which is a marked improvement over the results of previous applications of the UNIFAC method. If predictions of the solubility of n-paraffins are excluded, the percent deviation drops to 12.4. The average absolute deviation for the 29 hydrocarbon compounds is 15.2 ppm. (Author's abstract)
W89-10590

STUDY OF NITRATE AND NITRITE IN THALE SAP SONGKLA: WATER QUALITY OF THALE SAP SONGKLA I,
Prince of Songkla Univ. (Thailand). Dept. of Chemistry.
P. Kanatharana, and A. Chantanawatana.
Journal of Environmental Science and Health (A) JESEDU, Vol. A24, No. 1, p 87-96, January 1989. 4 fig, 2 tab, 3 ref.

Descriptors: *Lakes, *Water quality, *Eutrophication, *Water pollution effects, *Thailand, *Nutrients, *Water pollution sources, *Marine environment, *Nitrates, *Nitrites, Water quality data, Spectrophotometry, Water sampling, Municipal wastes, Canals, Water pollution, Flushing, Estuaries.

Thale Sap Songkla is the most seaward of the Songkla Lakes in Thailand, and is essentially a marine system which is flushed regularly by tidal exchange and by freshwater. It also receives urban liquid wastes from the local community through a small canal. A study of nitrate and nitrite in Thale Sap Songkla was carried out during 1985-1988. Water samples were collected every month and analyzed by spectrophotometry using the Brucine and cadmium reduction methods. Results from these studies show that nitrate concentrations were in the range of 0.001-0.069 mg/L during 1985-1986, 0.020-0.705 mg/L during 1986-1987, and 0.216-0.791 mg/L during 1987-1988. In the dry season, the concentrations of nitrate and nitrite were higher than those in the wet season on every station. The concentrations of nitrate and nitrite were highest at the stations near the canal outlet. The overall results indicate that nitrate and nitrite increased significantly (approximately 10-fold) between 1985 to 1988. (Author's abstract)
W89-10591

STUDIES ON THE GROUNDWATER POLLUTION IN ISLANDS: II. GROUNDWATER POLLUTION CAUSED BY SEAWATER INTRUSION AND FERTILIZER DISSOLUTION INTO PHREATIC AQUIFERS IN GOGO ISLAND, (JAPANESE),
Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
K. Inouchi, T. Kakinuma, and M. Sawa.
Japanese Journal of Limnology RIZAAU, Vol. 49, No. 4, p 237-250, October 1988. 14 fig, 4 tab, 15 ref. English summary.

Descriptors: *Groundwater pollution, *Saline water intrusion, *Fertilizers, *Aquifers, *Shallow wells, *Path of pollutants, Sulfates, Nitrates, Nitrites, Phosphorus, Chlorides, Conductivity, Gogo Island, Japan.

The problem of groundwater pollution caused by seawater intrusion and fertilizer dissolution into phreatic aquifers of Gogo Island, Ehime Prefecture, where the mandarin orange is widely cultivated is discussed. Groundwater levels, chloride concentrations and electric conductivities in shallow wells were measured in 5 districts. In the Kitaura district, sulfate, nitrate-N, nitrite-N and P concentrations were also measured. In the case of the fertilizer dissolution, a tank model is proposed which simulates the concentration variation with time in the phreatic aquifer. High chloride concentrations much greater than 200 mg/l, the standard for drinking water, were consistently found in coastal regions of the Yura district. The concentration of total ion except chloride, T-Cl, increases at 1-4 months after fertilization, and T-Cl correlates well with sulfate and nitrate-N (the multiple correlation coefficient is 0.88). The predicted temporal variations of concentration by the tank model agree well with the observed T-Cl variations by adopting relevant initial conditions and an alpha value which controls the fertilizer dissolution rate on the ground surface. (Author's abstract)
W89-10604

RADON CONCENTRATION IN GROUND WATERS IN SOME AREAS OF GRANITE INTRUSION IN VARIOUS AGES,
Saga Univ. (Japan). Faculty of Science and Engineering.
For primary bibliographic entry see Field 2K.
W89-10607

EFFECTS OF TREATED SEWAGE ON THE AVAILABILITY OF CADMIUM TO COHO SALMON,
Seattle Metro Water Quality Lab., WA.
For primary bibliographic entry see Field 5C.
W89-10637

HEAVY METAL UPTAKE BY PLANKTON AND OTHER SESTON PARTICLES,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
N. J. P. Revis, A. G. A. Merks, P. Valenta, and H. Rutzel.
Chemical Speciation and Bioavailability, Vol. 1,

No. 1, p 31-37, April 1989. 5 fig, 2 tab, 14 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Phytoplankton, *Zooplankton, Regression analysis, Lead, Cadmium, Copper, Chlorophyta, Cyanophyta, Dinoflagellates, Seston, Suspended solids.

The distribution of the heavy metals Cd, Cu, and Pb was studied for both the dissolved phase and the suspended matter in Zoommeer, a stagnant fresh-water lake, in order to determine if there was a link between heavy metals and seston particles. Phytoplankton and zooplankton were identified to species level and their density determined. The average surface area and average volume of each plankton species was calculated by measuring the dimensions of 20-200 specimens of each species. Heavy metal concentration in the dissolved phase and the particulate matter were determined by differential pulse anodic stripping voltammetry. The seston particles were divided into 10 subdivisions and the total surface area and volume of each subdivision was used as an independent variable for the subsequent multiple regression analysis to determine possible correlations with the heavy metal concentration. The determined regressions account for a very large part of the variation in the heavy metal concentrations (up to 98% for Pb, 99% for Cd, and 87% for Cu). An adsorption process appears to govern Cd and Pb uptake by Chlorophyceae and Dinophyceae. In addition, both Cd and Pb can penetrate into Chlorophyceae. In the case of Cu, a specific interaction with the Cyanophyceae has been found. In general, the uptake of heavy metals is highly specific for both the respective metal and the organism. (Author's abstract)
W89-10638

OIL AND GAS WASTE FLUIDS OF PENNSYLVANIA,
Moody and Associates, Inc., Meadville, PA.
B. W. Waite, and S. C. Blauvelt.
Northeastern Environmental Science NOESDE, Vol. 7, No. 2, p 105-110, 1988. 5 tab, 3 ref.

Descriptors: *Oil wastes, *Water pollution sources, *Oil wells, *Gas wells, *Brines, *Pennsylvania, Stimulation fluid, Production water, Shallow wells, Deep wells, Sodium chloride, Dissolved solids, Drilling additives, Stimulation additives, Drilling fluids.

Oil and gas wells of Pennsylvania are categorized as shallow if completed above the Middle Devonian Age Tully Formation, and deep if completed below this Stratigraphic marker bed. In combination with the primary product produced, the three primary well types are shallow oil, shallow gas, and deep gas. Shallow oil wells typically produce 0-2000 gallons of bottom hole brine water during drilling, 10-30 thousand gallons of stimulation fluids and 1-2 barrels per day of concentrated brine or connate water. Shallow gas wells average approximately 0-5000 gallons of bottom hole water, 40 thousand gallons of stimulation water and 0-1 barrels per day production water. Deep gas wells normally generate 0-25 thousand gallons of bottom hole drill water, 58 thousand gallons of stimulation fluid and 1-4 barrels per day of production water. Drilling and stimulation fluids are only generated once during the life of a typical oil or natural gas well, and are generally a combination of fresh water, formation water and various additives. Production fluids are generated during the life of an oil or natural gas well, which may exceed 20 years, and are highly concentrated in dissolved inorganic constituents (more so than drilling or stimulation fluids). Sodium chloride typically constitutes about half of the total dissolved solids in production fluids. Knowing the chemical nature and vloume of oil and natural gas well waste fluids is an essential first step in enacting appropriate management alternatives for these waste streams. (White-Reimer-PTT)
W89-10641

LEAD ISOTOPES AS SEEPAGE INDICATORS AROUND A URANIUM TAILINGS DAM,
Division of Exploration Geoscience, P.O. Box 136, North Ryde, NSW 2113, Australia.
B. L. Gulson, K. J. Mizon, and M. J. Korsch.
Environmental Science and Technology ESTHAG, Vol. 23, No. 3, p 290-294, March 1989. 5 fig, 16 ref.

Descriptors: *Lead radioisotopes, *Path of pollutants, *Isotopic tracers, *Seepage loss, *Uranium, *Mine wastes, Indicators, Pollutant identification, Boreholes, Radioactive half-life, Particulates, Membranee filters, Mass spectrometry, Water pollution, Australia.

Lead isotope measurements provide a definitive tool for establishing the source of lead in the environment. In the case of uranium mill railings from which the parent uranium has been extracted, the lead isotope composition will retain the characteristics of the original ore so that lead in any seepage from the tailings repository will be distinguishable from background lead. Lead isotope ratios and lead concentrations have been measured in water from 26 bores around the Ranger uranium tailings dam, Northern Territory, Australia, and from the dam itself to determine and possible migration of lead derived from the radioactive decay of uranium. Lead isotope compositions have also been measured for the particulates retained on selected membrane filters, analyzed by solid source thermal ionization mass spectrometer. The concentration of lead in the bore waters is extremely low (usually <1 part per billion). The Pb206/Pb204 ratio measured in the bore waters differs by more than a factor of 100 from that in the tailings dam and shows no evidence of lead derived from a significant uranium accumulation. It may be possible to distinguish between lead from the tailings dam and that derived from a nearby uranium ore body. (Author's abstract)
W89-10654

NATURAL TRACE METAL CONCENTRATIONS IN ESTUARINE AND COASTAL MARINE SEDIMENTS OF THE SOUTHEASTERN UNITED STATES,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 2K.
W89-10655

ACIDIC DEPOSITION AND CISTERN DRINKING WATER SUPPLIES,
Olem Associates, Washington, DC.
H. Olem, and P. M. Berthouex.
Environmental Science and Technology ESTHAG, Vol. 23, No. 3, p 333-340, March 1989. 4 fig, 3 tab, 32 ref. U.S. EPA TVA Interagency Agreement DW64931579.

Descriptors: *Acid rain, *Drinking water, *Water quality standards, *Water pollution effects, *Cisterns, Alkalinity, Cadmium, Copper, Lead, Zinc, Rain, Chemical properties, Hydrogen ion concentration, Sulfates, Neutralization, Plumbing, Calcium, Metals, Stability analysis.

Very little information is currently available on the relationship between acidic deposition and drinking water supplies. The water quality characteristics, including the trace elements Cd, Cu, Pb, and Zn, in rainwater cistern supplies representing an area receiving acidic deposition were compared to cistern water chemistry in a control area that does not receive a significant input of acidic deposition. Mean volume-weighted pH for bulk deposition was two pH units higher and SO4 was 50% lower in the control region. Rainwater was neutralized upon contact with cistern masonry in both regions, as indicated by a 1.5-unit increase in pH and an increase in calcium and alkalinity. While there seemed to be a clear difference in water quality for the two study regions, any difference in trace metals was marginal. Metal concentrations were below current drinking water limits in all but a few samples. Cistern water that remained in the home plumbing system overnight exceeded the proposed drinking water standard of 5 micrograms per liter for lead in 18 homes in the region receiving acidic deposition and 10 homes in the control region. No relation between metal concentrations and roofing material, plumbing materials, or water stability indices could be found. (Author's abstract)
W89-10656

DIFFUSIVE CONTAMINANT TRANSPORT IN NATURAL CLAY: A FIELD EXAMPLE AND IMPLICATIONS FOR CLAY-LINED WASTE DISPOSAL SITES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
R. L. Johnson, J. A. Cherry, and J. F. Pankow.
Environmental Science and Technology ESTHAG, Vol. 23, No. 3, p 340-349, March 1989. 7 fig, 3 tab, 27 ref.

Descriptors: *Landfills, *Linings, *Waste disposal, *Groundwater pollution, *Diffusivity, *Path of pollutants, Clays, Field tests, Hazardous materials, Cores, Saturated soils, Chlorides, Organic compounds, Volatility, Chemical analysis, Permeability, Ontario.

Clay liners are frequently employed at waste disposal sites as a means of minimizing the potential for groundwater contamination. It is desirable to understand the nature of diffusive transport through clay beneath an actual hazardous waste disposal site. A field investigation was performed wherein vertical core samples were obtained from an impervious, unweathered, water-saturated clay deposit beneath a five-year-old hazardous waste landfill at a site in southwestern Ontario. Sections of the cores were analyzed for chloride and volatile organic compounds. Waste-derived chloride was detected in the clay to a maximum depth of 83 cm below the bottom of the landfill. The most mobile organic compounds were found only to a depth of approximately 15 cm. The downward transport of these chemical species into the clay was the result of simple Fickian diffusion. This study has implications for low-permeability clay liners used at waste disposal sites. For liners of typical thickness (approximately 1 m), simple diffusion can cause breakthrough of mobile contaminants in approximately five years; the diffusive flux of contaminants out of such liners can be large. (Fish-PTT)
W89-10657

DISTRIBUTION OF ENTEROTOXIGENIC CLOSTRIDIUM PERFRINGENS IN WATER AND SOIL IN THE SOUTHERN PART OF HOKKAIDO,
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
S. Oka, Y. Ando, and K. Oishi.
Nippon Suisan Gakkaishi NSUGAF, Vol. 55, No. 1, p 71-78, January 1989. 2 fig, 6 tab, 40 ref.

Descriptors: *Bacterial analysis, *Clostridium, *Enteric bacteria, *Pollutant identification, *Human diseases, Poisons, Anaerobic bacteria, Heat resistance, Water sampling, Soil bacteria, Sewage bacteria, Animal wastes, Coastal waters, Japan.

Clostridium perfringens is widely distributed in nature, such as in soil, human and animal feces, sewage, etc., and it is well known as one of the important anaerobic strains causing human food poisoning. It is believed that both heat-resistant and heat-sensitive strains are involved in food poisoning. The distribution and enterotoxin production of C. perfringens in water and soil samples from various sources in the southern part of Hokkaido were investigated. In addition, Hobbs' serological typing of isolates from these samples was performed by the agglutination test using the Hobbs' types 1 to 17 antisera. Of six kinds of water samples, sewage and river water samples tended to show higher detection rates of C. perfringens in samples heated at both 75 and 100 degrees C. It is supposed that the sources of the organisms detected in river water were sewage, soil, and animal feces. All sea water samples that showed positive for C. perfringens were collected from coastal locations in and near the city, heated to 75 degrees C, and are believed to be polluted with river water or sewage contaminated with the organisms. The organisms were also detected in three kinds of soil samples heated at 75 degrees C and in one kind of soil sample heated at 100 degrees C. Enterotoxigenic strains were detected in 7.2% of isolates from the water samples heated at 75 degrees C, in 6.1% from the water samples heated at 100 degrees

C, in 1.7% of soil samples heated at 75 degrees, and in 14.3% of the soil samples heated at 100 degrees C. A total of 30 Hobbs' serotype strains detected in water and soil samples were also divided into 6 serotypes. (Fish-PTT)
W89-10659

CHLORINATED HYDROCARBONS IN ECOSYSTEMS OF THE NORTH ATLANTIC,
I. G. Orlova.
Oceanology ONLGAE, Vol. 27, No. 6, p 701-705, June 1988. 1 fig, 6 tab, 18 ref.

Descriptors: *Path of pollutants, *Chlorinated hydrocarbons, *Fate of pollutants, *Marine environment, *Water pollution sources, Hydrobiology, Marine sediments, Bottom sediments, Species composition, Bioaccumulation, Zooplankton, Phytoplankton, Clays, Ooze, Atlantic Ocean.

Data on the distribution of chlorinated hydrocarbons, including organochlorine pesticides and polychlorinated biphenyls (PCBs), in ecosystem components of the North Atlantic, i.e., water, hydrobionts, and bottom sediments, for the period 1980-1984 are presented. The distribution characteristics are considered as a function of various factors (physiographic conditions of the area, species makeup of zooplankton, mineralogic composition of bottom sediments) for each of the ecosystem components. The distribution or concentration factors of chlorinated hydrocarbons in individual hydrobionts and bottom sediments are determined. The maximum distribution coefficients are those of integral plankton samples (up to five orders of magnitude of concentration). Analysis of the distribution of chlorinated hydrocarbons in three types of bottom sediments in the North Atlantic indicated that they accumulated to a greater degree in clay or argillaceous ooze, and are widespread in various elements of the North Atlantic ecosystem. The degree of pollution accumulation appears to be directly dependent on environmental pollutant concentrations. (Fish-PTT)
W89-10665

ALUMINIUM AND ACID RAIN: MITIGATING EFFECTS OF NACL ON ALUMINIUM TOXICITY TO BROWN TROUT (SALMO TRUTTA FARIO) IN ACID WATER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Toxicology.
For primary bibliographic entry see Field 5C.
W89-10667

INVESTIGATION OF FAILURE MECHANISMS AND MIGRATION OF ORGANIC CHEMICALS AT WILSONVILLE, ILLINOIS,
Illinois State Geological Survey Div., Champaign.
B. L. Herzog, R. A. Griffin, C. J. Stohr, L. R. Follmer, and W. J. Morse.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 82-89, Spring 1989. 3 fig, 2 tab, 19 ref. EPA Cooperative Agreement R810442-01.

Descriptors: *Groundwater pollution, *Sanitary landfills, *Hazardous waste disposal, *Liquid wastes, *Organic compounds, *Geologic factures, *Path of pollutants, *Illinois, Hydraulic conductivity, Monitoring, Wells, Trenches.

Groundwater contamination was discovered in 1981 in a monitoring well at the Earthline disposal facility near Wilsonville, Illinois. Organic chemicals had migrated at a rate 100-1000 times greater than predicted when the site received its permit to operate in 1978. Postulated failure mechanisms included migration through previously unmapped permeable zones, subsidence of an underground mine, organic-chemical and clay-mineral interactions, acid-mine drainage and clay interactions, trench-cover settlement, and erosion. The Illinois state Geological Survey found the primary reason for the rapid migration: the presence of previously undetermined fractures and joints in glacial till. The inaccurate predictions of hydraulic conductivity were based on laboratory-determined values that did not adequately measure the effects of fractures and joints on the transit time calculations. Field-measured hydraulic conductivity values were generally 10-1000 times greater than their laboratory-measured counterparts, thus largely accounting for the discrepancy between predicted and actual migration rates in the transit time calculations. The problem was compounded, however, by the burial of liquid wastes and by trench covers that allowed excess surface runoff to enter the trenches. Organic-chemical and clay-mineral interactions may also have exacerbated the problem in areas where liquid organic wastes were buried. (Author's abstract)
W89-10680

LIMITATIONS OF MONITORING WELLS FOR THE DETECTION AND QUANTIFICATION OF PETROLEUM PRODUCTS IN SOILS AND AQUIFERS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 7A.
W89-10681

ENVIRONMENTAL RADIOACTIVITY AND DOSE EVALUATION IN TAIWAN AFTER THE CHERNOBYL ACCIDENT,
National Tsing Hua Univ., Hsinchu (Taiwan). Inst. of Nuclear Science.
C. Chung.
Health Physics HLTPAO, Vol. 56, No. 4, p 465-471, 1989. 1 fig, 6 tab, 19 ref. Republic of China Atomic Energy Council contract AEC77-C41-K2 and National Science Council contract NSC75-0413-E007-11.

Descriptors: *Nuclear powerplants, *Chernobyl, *Radioactivity, *Fallout, *Fate of pollutants, *Taiwan, Air pollution, Chemistry of precipitation, Public health.

A substantial increase in fission product activity was observed in various environmental samples taken in Taiwan after the Chernobyl accident. The concentrations of long-lived fission products in air above ground, precipitation, grass, and milk were monitored in the next 7 weeks. The levels of contamination were comparable to the levels reported in a 1977 Chinese atmospheric nuclear test but two orders of magnitude less than those measured in Western Europe after the Chernobyl accident. The individual effective dose equivalents, committed from the first year of exposure and intake following the accident, were evaluated as 0.8 microSv for adults, 1.2 microSv for children, and 2.1 microSv for infants in Taiwan. The collective doses for citizens in Taiwan were 18 man Sv, less than 0.05% of annual background collective doses caused by natural radiation. These values are lower than those reported in neighboring countries in the Far East and pose no increased health impact to the public in Taiwan. (Author's abstract)
W89-10685

IMPACT ASSESSMENT OF ACID DEPOSITION CONTROL BILLS: AN EVALUATION OF SELECTED MODELS,
Cincinnati Univ., OH. School of Planning.
H. Briassoulis.
Journal of Environmental Management JEVMAW, Vol. 28, No. 2, p 175-184, March 1989. 34 ref.

Descriptors: *Model studies, *Acid deposition, *Acid rain, *Environmental policy, *Policy making, *Legislation, Environmental effects, Economic impact, Evaluation, Comparison studies.

Most of the bills proposed for acid deposition control in the United States since 1981 have been analyzed with respect to their economic and environmental impacts, but the results obtained from the impact assessment of these bills differ considerably and offer no solid basis for basing policy decisions on them. This paper evaluates the policy relevance of a selection of models--single-region econometric, optimization, and multi-regional economic models--which have been employed for the assessment of impacts of acid deposition control bills. The effects of model caveats, consideration of alternative options, and the value of the policy guidance offered by the models applied are analyzed. The existing assessment frameworks offer only partial impact assessments, often highly uncertain and dependent upon the validity and reliability of the underlying assumptions, restricted to a limited number of alternative solutions, and removed from the needs of policy makers. Suggestions are offered for an alternative impact assessment framework and its place within the actual acid deposition policy-making setting. (Author's abstract)
W89-10700

COMPARISON OF PARAMETERIZED NITRIC ACID RAINOUT RATES USING A COUPLED STOCHASTIC-PHOTOCHEMICAL TROPOSPHERIC MODEL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. W. Stewart, A. M. Thompson, M. A. Owens, and J. A. Herwehe.
Journal of Geophysical Research (D) Atmospheres JGRDE3, Vol. 94, No. 4, p 5219-5226, April 20, 1989. 7 fig, 1 tab, 10 ref.

Descriptors: *Precipitation, *Chemistry of precipitation, *Model studies, *Nitric acid, *Acid rain, Photochemistry, Precipitation scavenging, Statistical models.

A major tropospheric loss of soluble species such as nitric acid results from scavenging by water droplets. Several theoretical formulations have been advanced which relate an effective time independent loss rate for soluble species to statistical properties of precipitation such as the wet fraction and length of a precipitation cycle. There is not enough data available on trace species concentrations to test the computational results of alternative loss rate models against observations. Therefore, in this paper various 'effective' loss rates that have been proposed are compared with the results of detailed time dependent model calculations carried out over a seasonal time scale. The model developed for this purpose is a stochastic precipitation model coupled to aa tropospheric photochemical model. The results of numerous time dependent seasonal model runs are used to derive numerical values for the nitric acid residence time for several assumed sets of precipitation statistics. These values are then compared with the results obtained by utilizing theoretical 'effective' loss rates in time dependent models. (Author's abstract)
W89-10701

SIMPLE MODEL SYSTEM FOR SMALL SCALE IN VITRO STUDY OF ESTUARINE SEDIMENT ECOSYSTEMS,
Aberdeen Univ. (Scotland). Dept. of Genetics and Microbiology.
K. Hillman, G. W. Gooday, and J. I. Prosser.
Letters in Applied Microbiology LAMIE7, Vol. 8, No. 2, p 41-44, February 1989. 1 fig, 1 tab, 7 ref.

Descriptors: *Model studies, *Estuaries, *Sediments, *Ecosystem models, *Model studies, Hydrogen ion concentration, Temperature, Chitin, Chitosan, Enzymes, Ythan estuary, Scotland.

A model was developed to be closely imitative of the natural estuarine ecosystem, simple in construction, and easy to maintain. The system is self-contained and requires no additional nutrient input. It allows for operator control over some environmental factors such as pH and temperature, and will permit experiments involving the addition of toxic chemicals to estuarine sediments. The current model has been in continuous operation for 10 months without replacement of the original sediment, and the sediment structure and major sediment meiofauna have been maintained. The system has been used in studies of chitinase, chitin and chitosan content of surface sediments from the model and from the Ythan estuary, Scotland. There were no significant differences in the values of the chitinolytic systems of the model and natural sediments. (Sand-PTT)
W89-10702

SOLUTE AND PARTICULATE CHEMISTRY OF BACKGROUND VERSUS A POLLUTED, BLACK SNOWFALL ON THE CAIRNGORM MOUNTAINS, SCOTLAND,
University of East Anglia, Norwich (England). School of Environmental Sciences.
S. Landsberger, T. D. Davies, M. Tranter, P. W. Abrahams, and J. J. Drake.
Atmospheric Environment ATENBP, Vol. 23, No. 2, p 395-401, February 1989. 2 fig, 4 tab, 32 ref. NERC grants GR3/5144A and GST/02/205. EEC grant ENV/782/UK.

Descriptors: *Dissolved solids, *Snow, *Particulate matter, *Path of pollutants, *Air pollution, Aluminum, Bromine, Calcium, Chlorine, Copper, Iron, Iodine, Magnesium, Manganese, Sodium, Lead, Sulfur, Vanadium, Barium, Cobalt, Titanium, Uranium, Scotland, Trace metals.

The solute (Al, Br, Ca, Cl, Co, Cu, Dy, I, Mn, Na, Ti, U and V) and particulate (Al, Ba, Br, Ca, Cl, Co, Cu, Dy, I, Mn, Na, Ti, U and V) chemistry of a relatively unpolluted snowfall, associated with a maritime air mass, is presented, to characterize background conditions for the region. The variability of the concentration of solute and the chemical composition of particulate material is investigated on an intra-and inter-site basis. The seasalt solute component is less variable then the terrigenous component. Hence, the aerosol scavenged by the snow is assumed to be a mixture of at least two components. The solute content of a relatively polluted, black snow is distinctly different from background snowfall. However, there is little difference in the chemistry of particulate material with diameter >0.45 micrometers. Most lithophiles have enrichment factors (EF) close to 1, whereas only the chalcophiles and halogens have EF>10. At most, the EF of each of the 14 elements considered differs by a factor of 5 between polluted and background snow. Particulate material gathered from within snowpack in the same region has a similar range of EF values to those obtained from both snows. There is the potential for toxic effects associated with trace metal release during snowmelt of both polluted and marine snows. (Author's abstract)
W89-10708

ATMOSPHERIC ACIDITY MEASUREMENTS ON ALLEGHENY MOUNTAIN AND THE ORIGINS OF AMBIENT ACIDITY IN THE NORTHEASTERN UNITED STATES,
Ford Motor Co., Dearborn, MI. Research Staff.
W. R. Pierson, W. W. Brachaczek, R. A. Gorse, S. M. Japar, and J. M. Norbeck.
Atmospheric Environment ATENBP, Vol. 23, No. 2, p 431-459, February 1989. 13 fig, 6 tab, 77 ref.

Descriptors: *Acid rain, *Sulfates, *Nitrates, *Ozone, *Path of pollutants, Aerosols, Regional analysis, Pennsylvania.

Atmospheric acidity as HNO3 (g), SO2 (g), and aerosol H(+) was measured on Allegheny Mountain and Laurel Hill in southwest Pennsylvania in August 1983. The aerosol H(+) appeared to represent the net after H2SO4 reaction with NH3(g). The resulting H(+)/SO4(--) ratio depended on SO4(--) concentration, approaching that of H2SO4 at the highest SO4(--) concentrations. The atmosphere was acidic; the average concentrations of HNO3 (78 nmole/cu m) and aerosol H(+) (205 nmol/cu m), NH4(+) (172 nmole/cu m) and SO4(--) (201 nmole/cu m), and the dearth of NH3 (<15 nmole/cu m), show that the proton acidity (HNO3, H2SO4) of the air exceeded the acid-neutralizing capacity of the air by a factor of >2, with one 10-hr period averaging 263 and 844 nmole/cu m for HNO3 and aerosol H(+), respectively. SO2 added another 900 nmole/cu m (average) of potential H(+) acidity. HNO3 and aerosol H(+) episodes were concurrent, on 7-8 day cycles, sporadic like SO2. Laurel and Allegheny, separated by 35.5 km, were essentially identical in aerosol SO4(--), less so in HNO3 and especially less so in SO2; apparently, chemistry involving HNO3 and aerosol H(+), or SO4(--) was slow compared to inter-site transport times (1-2 hr). HNO3 declined at night. The O3 concentration (average 56 ppb or 2178 nmole/cu m) connotes an oxidizing atmosphere conducive to acid formation. Highest atmospheric acidity was associated with (1) slow westerly winds traversing westward SO2 source areas, (2) local stagnation, or (3) regional transport around to the back side of a high pressure system. Low acidity was associated with fast-moving air masses and with winds from the northerly directions; upwind precipitation also played a moderating role in air parcel acidity. Much of the SO2 and NOx, and ultimately of the HNO3 and aerosol H(+), appeared to originate from coal-fired power plants. Size distributions of aerosol H(+) and SO4(--) were alike. An accounting of aerosol mass showed that H2O aerosol caused much of the observed light scattering. (Author's abstract)
W89-10709

SULPHUR DIOXIDE AND SULPHATE IN A THREE-DIMENSIONAL FIELD OF CONVECTIVE CLOUDS: NUMERICAL SIMULATIONS,
Atmospheric Environment Service, Downsview (Ontario).
M. Niewiadomski.
Atmospheric Environment ATENBP, Vol. 23, No. 2, p 477-487, February 1989. 9 fig, 1 tab, 49 ref.

Descriptors: *Acid rain, *Clouds, *Sulfur compounds, *Sulfates, *Model studies, *Mathematical models, Numerical analysis, Path of pollutants, Aerosols, Simulation analysis, Oxidation, Deposition, Convection.

A three-dimensional numerical model of convective and turbulent transport of SO2 and sulfate aerosol as well as their scavenging, oxidation and wet deposition has been formulated and applied to a field of relatively sparse and weak cumuli. Simulations were carried out in a large domain, comparable with one grid cell of Eulerian LRTAP models and including many clouds in various stages of development. For the case studied, the main source of the liquid water sulfate content appeared to be nucleation scavenging. The redistribution of the aerosol and SO2 in the domain of the model resulted mainly from their passive transport by vertical air motions associated with clouds. The effects of scavenging and heterogeneous chemistry were of secondary importance. (Author's abstract)
W89-10710

SHORT TERM SURVEY OF DAILY RAINFALL ACIDITY IN THE U.K.,
Open Univ., Milton Keynes (England).
A. Porteous, and R. S. Barrati.
Atmospheric Environment ATENBP, Vol. 23, No. 2, p 509-512, February 1989. 1 fig, 1 tab, 5 ref.

Descriptors: *Acid rain, *Regional analysis, *United Kingdom, Path of pollutants, Sulfates, Hydrogen ion concentration, Spatial distribution, Acidic water.

Short term surveys of rainfall acidity in the United Kingdom (U.K.) are carried out annually at a very large number of sites throughout the country by over 250 students of the Open University. Students measured the rainfall daily as it occurred thereby approximating event sampling in a similar manner to the U.K. Primary Network. Measurements were made over 30-day periods at an average of 260 sites in the spring seasons of 1986 and 1987. Summaries of the pH of rainfall on a daily basis and expressed as an average for each county are reported. Results show that the data are broadly comparable for the two years studied. The parts of the country experiencing similar acidity in rainfall year by year are similar. The least acidic rainfall consistently appears in the western part of the country and in the south, whereas highest acidity is found ni the east Midlands and also in the northeast. The incidence of certain local variations is apparent in the data. A high pH in Cleveland in 1986 was attributed to a nearby NH3-works. The local effects and variations between neighboring sites, especially urban and rural, are clearly aspects for further investigation. The data set for 1987 suggest that the acid rain observed over 100 years ago in Manchester is still to be found. (Geiger-PTT)
W89-10711

PRODUCTION AND RELEASE OF DIMETHYL SULFIDE FROM THE GREAT LAKES,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W89-10712

ORGANIC AND INORGANIC ACIDS IN RAIN FROM A REMOTE SITE OF THE VENEZUELAN SAVANNAH,
Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
E. Sanhueza, W. Elbert, A. Rondon, M. C. Arias, and M. Hermoso.
Tellus TELLAL, Vol. 41B, No. 2, p 170-176, April 1989. 3 fig, 3 tab, 26 ref.

Descriptors: *Acid rain, *Venezuela, *Ecosystems, Hydrogen ion concentration, Acetic acid, Air pollution, Path of pollutants, Ammonia, Rainfall, Vegetation effects, Acidic water, Ions.

The chemical characterization of rain events collected at a remote site in the Venezuelan savannah are reported. The volume-weighted average pH was 4.7. In most of the samples over 60% of the free acidity may be due to formic and acetic acids. Sulfuric and nitric acids only contribute with < or = 40%. The potential contribution of HCl is relatively high, up to 16%. Ammonium ion concentrations were lower than the values observed in other natural tropical ecosystems. Rain samples collected during the period of vegetation burning show less free acidity (pH > 5.3) and higher concentration of all the ions than those collected in the non-burning periods. (Author's abstract)
W89-10713

BIOGEOCHEMICAL ASPECTS OF ATMOSPHERIC METHANE,
National Center for Atmospheric Research, Boulder, CO.
R. J. Cicerone, and R. S. Oremland.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 299-327, December 1988. 11 fig, 4 tab, 299 ref. NASA grant W-16,184.

Descriptors: *Geochemistry, *Methane, *Air pollution, *Carbon monoxide, Ozone, Oxidation, Microbial degradation, Path of pollutants, Literature review.

Methane is the most abundant organic chemical in Earth's atmosphere, and its concentration is increasing with time, as a variety of independent measurements have shown. Photochemical reactions oxidize methane in the atmosphere; through these reactions, methane exerts strong influence over the chemistry of the troposphere and the stratosphere and many species including ozone, hydroxyl radicals, and carbon monoxide. Also, through its infrared absorption spectrum, methane is an important greenhouse gas in the climate system. The key roles and reactions of methane are described and enumerated. Two kinds of methane production are examined in detail: microbial and thermogenic. Microbial methanogenesis is described, and key organisms and substrates are identified along with their properties and habitats. Microbial methane oxidation limits the release of methane from certain methanogenic areas. Both aerobic and anaerobic oxidation are described along with methods to measure rates of methane production and oxidation experimentally. Indicators of the origin of methane, including C and H isotopes, are reviewed. Several constraints on the budget of atmospheric methane, its sources, sinks and residence time are identified and evaluated. From these constraints and other data on sources and sinks, a list of sources and sinks, identities, and sizes are constructed. The quasi-steady state annual source (or sink) totals about 310 (+or-60) trillion mol (500(+or-95) trillion g), but there are many remaining uncertainties in source and sink sizes and several types of data that could lead to stronger constraints and revised estimates in the future. It is particularly difficult to identify enough sources of radiocarbon-free methane. (Author's abstract)
W89-10715

METHANE PRODUCTION AND OXIDATION IN LAKES IMPACTED BY THE MAY 18.1980 ERUPTION OF MOUNT ST. HELENS,
Washington Univ., Seattle. School of Oceanography.
M. D. Lilley, J. A. Baross, and C. N. Dahm.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 357-370, December 1988. 12 fig, 3 tab, 36 ref. NSF grant DEB-811307. NASA grant NAGW-840.

Descriptors: *Geochemistry, *Limnology, *Volcanoes, *Methane, *Oxidation, *Volcanoes, *Lakes, Organic matter, Dissolved solids, Dissolved oxygen, Path of pollutants.

The concentrations of CH4 and CH4 oxidation rates were measured in lakes impacted by the May 18, 1980 eruption of Mount St. Helens. The highest CH4 concentrations were recorded during the first summer after the eruption and ranged in surface waters from 5 microM in the moderately impacted Ryan Lake to 28 microM in the heavily impacted North Coldwater Lake. At depths below the oxic/anoxic interface, CH4 levels reached 250 microM in North Coldwater Lake, 184 microM in Spirit Lake, 70 microM in Castle Creek Lake, and 60 microM in Ryan Lake. The CH4 flux measurements from these lakes during the summer following the May 18, 1980 eruption were the highest ever recorded in lakes with ranges of 1.1-2.9 mmol CH4/sq m/day in the light to moderately impacted McBride and Ryan Lakes to ranges of 17.4-25.3 mmol CH4/sq m/day in the heavily impacted Castle Creek, North Coldwater, and Spirit Lakes. Evidence of CH4 oxidation was seen in all of the lakes during the summer of 1981, and rates of CH4 oxidation using C14-CH4 were measured in spirit Lake from 1982 to 1986. The highest rates of CH4 oxidation measured were during the summer stratification and ranged from 50 to 150 nmol CH4 oxidized/L/day. Methane oxidation rates were measured in waters having oxygen concentrations less than 100 microM with highest activity occurring at concentrations of 30-60 microM. Spirit Lake samples taken during 1986 showed a marked reduction in the levels of CH4. This has corresponded with a marked reduction in the levels of dissolved organic material in the lake and an apparent decline in sedimentary methanogenesis. The lakes heavily impacted by the eruption of Mount St. Helens, while having gone through a 2-3 year period of eutrophy following the massive input of organic wood debris and inorganic nutrients associated with ash and pyroclastic materials, are presently rapidly returning to preeruption conditions characteristic of oligotrophic, subalpine lakes. (Author's abstract)
W89-10718

ISOTOPIC COMPOSITION OF METHANE RELEASED FROM WETLANDS: IMPLICATIONS FOR THE INCREASE IN ATMOSPHERIC METHANE,
Washington Univ., Seattle. School of Oceanography.
P. D. Quay, S. L. King, J. M. Lansdown, and D. O. Wilbur.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 4, p 385-397, December 1988. 5 fig, 2 tab, 40 ref. NASA grants NAGW-844, NAGW-711 and NAGW-1066.

Descriptors: *Biochemistry, *Geochemistry, *Methane, *Isotopes, *Wetlands, *Minnesota, *Peat bogs, Tundra, Arctic regions, Tropical regions, Temperate zone, Livestock, Path of pollutants, Biomass.

Measurements of the delta-C13 of methane released from tropical, temperate, and arctic wetland sites are reported. The mean delta-D13 values (relative to PDB carbonate standard) for peat bogs and Alaskan tundra are -53 +or-8, -66 +or-5 and -64 +or-5 o/oo, respectively. These measurements combined with methane flux estimates yield a flux-weighted global average delta-C13 value of -59 +or-6 o/oo for methane released from wetlands, a major natural methane source. The agreement between the measured delta-C13 for methane emitted from wetlands and the calculated steady state value of approximately -6 o/oo for the delta-C13 of preindustrial methane sources suggests that methane was predominantly produced biogenically in the preindustrial era. The industrial era time rate of change of the delta-C13 of the global methane flux is calculated from estimates of the growth rate of the major anthropogenically derived methane sources and the C13 composition of these sources, and compared to the measured change in the delta-C13 of methane during the last 300 years. Based on these results, it is estimated that 13 +or-8% of the current global methane flux is derived abiogenically from natural gas and biomass burning, whereas the remainder is derived biogenically primarily from wetlands, rice paddies, and livestock. (Author's abstract)
W89-10720

DIFFUSIVE FLUX OF METHANE FROM WARM WETLANDS,
University of South Florida, St. Petersburg. Dept. of Marine Science.
For primary bibliographic entry see Field 2H.
W89-10722

SEASONAL VARIATIONS IN EBULLITIVE FLUX AND CARBON ISOTOPIC COMPOSITION OF METHANE IN A TIDAL FRESHWATER ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W89-10725

METHANE EFFLUX FROM THE PELAGIC REGIONS OF FOUR LAKES,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2H.
W89-10726

CARBON ISOTOPIC COMPOSITION OF METHANE IN FLORIDA EVERGLADES SOILS AND FRACTIONATION DURING ITS TRANSPORT TO THE TROPOSPHERE,
North Carolina Univ. at Chapel Hill. Marine Sciences Program.
For primary bibliographic entry see Field 2H.
W89-10728

SOURCES OF ATMOSPHERIC METHANE IN THE SOUTH FLORIDA ENVIRONMENT,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. C. Harriss, D. I. Sebacher, K. B. Bartlett, D. S. Bartlett, and P. M. Crill.
Global Biogeochemical Cycles GBCYEP, Vol. 2, No. 3, p 231-243, September 1988. 3 fig, 6 tab, 35 ref.

Descriptors: *Biochemistry, *Geochemistry, *Land use, *Urbanization, *Methane, *Wetlands, *Florida, *Marshes, Livestock, Path of pollutants, Regional analysis, Air pollution.

Direct measurement of methane (CH4) flux from wetland ecosystems of south Florida demonstrates that freshwater wet prairies and inundated sawgrass marsh are the dominant sources of atmospheric CH4 in the region. Fluctuations in soil moisture are an important environmental factor controlling both seasonal and interannual fluctuations in CH4 emissions from undisturbed wetlands. Land use estimates for 1900 and 1973 were used to calculate regional CH4 flux. Human settlement in south Florida has modified wetland sources of CH4, reducing the natural prairies and marsh sources by 37%. During the same period, impoundments and disturbed wetlands were created which produce CH4 at rates approximately 50% higher than the natural wetlands they replaced. Preliminary estimates of urban and ruminant sources of CH4 based on extrapolation from literature data indicate these sources may now contribute approximately 23% of the total regional source. It was estimated that the integrated effects of urban and agricultural development in south Florida between 1900 and 1973 resulted in a 26% enhancement in CH4 flux to the troposphere. (Author's abstract)
W89-10729

ELEMENT COMPOSITION OF MUNICIPAL REFUSE ASHES AND THEIR AQUEOUS EXTRACTS FROM 18 INCINERATORS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Toxic Chemicals Lab.
D. J. Lisk, C. L. Secor, M. Rutzke, and T. H. Kuntze.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 534-539, April 1989. 3 tab, 9 ref.

Descriptors: *Leaching, *Water pollution sources, *Path of pollutants, *Ash, *Chemical analysis, Incineration, Municipal wastes, Heavy metals, Hydrogen ion concentration, Organic compounds, Inorganic compounds, Leachates, Wastewater treatment, Landfills, Management planning.

Ashes from 18 municipal refuse incinerators (about one fourth of those currently operating in the United States) were extracted with water and the quantity of 20 elements and nitrate was determined in the ashes and aqueous extracts. Al, Ca, Fe, K, Mg, Na, and S are consistently the major elements in the ashes. There does not appear to be any consistent relation between the type of ash and the content of specific elements. There appears to be little relation between the total concentration of specific elements in the ashes or their pH and the quantities of elements extracted from them by water. Fe, Mn, Ni, and Zn were all relatively high in the water extract of the most acidic ash.; the dissolution of these elements would be favored by low pH. The forms of elements in refuse ashes may include soluble salts, metal oxides, precipitates, and many other complex inorganic and organic compounds varying greatly in solubility. Knowledge of the composition of municipal refuse incinerator spray and quench waters is relevant because these waters may be discharged to wastewater treatment plants. Similarly, knowledge of chemical composition of the ash from these incinerators is pertinent to their disposal in landfills. (Rochester-PTT)
W89-10733

FATE OF 14C NITROFEN IN RICE PADDY ECOSYSTEM,
Bhabha Atomic Research Centre, Bombay (India). Nuclear Agriculture Div.
S. P. Kale, and K. Raghu.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 544-547, April 1989. 1 tab, 7 ref.

Descriptors: *Tracers, *Fate of pollutants, *Path of pollutants, *Pesticides, *Biodegradation, *Rice, *Nitrofen, Isotope studies, Isotopic tracers, Carbon radioisotopes, Fate of pollutants, Gambusia, Chara, Snails, Soil contamination, Microcosms.

The fate of 14C nitrofen (2,4-dichlorophenyl 4'-nitrophenyl ether) in a rice paddy microecosystem was followed for 120 days. The ecosystem was established in an all glass aquarium tank (18 x 10 x 12 inches). The tank was divided into two compartments, the larger of which was filled with 10 kg black clay soil. Ten-day old rice seedlings, fish (Gambusia), and the alga Chara were introduced into this system; snails were already present in the soil. 14C nitrofen was mixed with unlabeled nitrofen in acetone and applied to the tanks at the rate of 10 l/ha on a surface-area basis. Samples of fish, rice plants, soil, water, snail, and algae were collected at intervals of 10, 20, 30, 40, and 120 days. The nitrofen underwent rapid degradation, with 101.05% of 14C residues detectable at 10 days, but only 6.07% detectable at 120 days. Both extractable and bound residues were low in fish, snail, and algae at any of the time intervals sampled. This indicated that residues of nitrofen did not bioaccumulate. Of the many components of rice paddy ecosystem, only soil showed considerable 14C residues in both extractable and bound forms. At 10 days soil showed total residues of 90.12%, which decreased to 5.66% at the end of 120 days. From the enhanced reduction of 14C residues observed here, it is clear that nitrofen was degraded rapidly under semi-tropical conditions. These observations

suggest strongly that there is a need for studying the fate of pesticides in the rice paddy ecosystem under simulated outdoor field conditions. (Rochester-PTT)
W89-10735

WATER CONTAMINATION BY HEAVY METALS (HG, CD, PB, CU AND ZN) IN DONANA NATIONAL PARK (SPAIN),
Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Inst. de Quimica Organica General.
M. C. Rico, L. M. Hernandez, and J. Gonzalez.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 582-588, April 1989. 1 fig, 4 tab, 8 ref.

Descriptors: *Mercury, *Spain, *Heavy metals, *Water pollution sources, *Path of pollutants, Donana National Park, Guadalquivir River, Pyrite, Mine drainage, Zinc, Lead, Copper, Manganese, Cadmium, Mercury.

The Donana National Park has on one side the Guadalquivir River, Spain, which has a mine about 40 km upstream from the northern boundary of the park. The mine is being operated for commercial exploitation of pyrite ores in Zn, Pb, Cu, and Mn. The watershed of the Donana Park and the mining area and intervening stream were sampled to detect any possible heavy metal contamination that might be coming to the park from the mining area. All heavy metals were found in all samples analyzed. Cadmium showed the lowest mean concentration, with a range from 0.1 to 4.2 ppb, followed by Hg (0.3-6.1 ppb), Pb (1.4-41.6 ppb); Cu (10.5-50.2 ppb), and Zn (5.4-842.9 ppb). All samples analyzed exceeded the natural levels in freshwater for heavy metal; 6% of the samples for Hg, 9.5% for Cd, 5.8% for Pb, 5.4% for Cu, and 4.1% for Zn exceeded the maximum allowable levels (USEPA). For all the metals but Hg, these samples were associated with the mining area. Correlations among residues of heavy metals were highly significant or significant for all metals except Hg. This may be because the emission source of Cd, Pb, Cu, and Zn, but not Hg, is located at the mine of Aznalcollar. The origin of Hg pollution is in agricultural and industrial activities in the proximity of the park. (Rochester-PTT)
W89-10736

LEVELS OF CHLORDANE IN WATER AND SEDIMENT OF RIVERS AROUND SAGA CITY, JAPAN,
Saga Medical School (Japan). Dept. of Community Health Science.
Y. Hirai, and K. Tomokuni.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 589-594, April 1989. 2 fig, 1 tab, 6 ref. Ministry of Education, Science and Culture (Japan), Grant-in-Aid for Scientific Research 62770351.

Descriptors: *Pesticides, *Japan, *Insecticides, *Path of pollutants, *Urban areas, *Chlordane, Saga City, River sediments, Rivers, Wastewater pollution, Water supply.

Chlordane levels were determined at numerous sites in rivers supplying water to the city of Saga, Japan, and in drainage rivers receiving runoff and wastewater from the urbanized area. River sediments also were sampled in the urbanized area. Chlordane was not detected in water-supplying rivers in the upstream mountain area. The levels of chlordane were low even at an urban area where the inflow of wastewater from houses and industries was smaller. In contrast, chlordane was detected in all water samples from the drainage rivers. The concentration of chlordane in water ranged from undetectable to 20 ng(nanogram)/l; the median was 3 ng/l. The concentration of chlordane in river sediment ranged from 0.5 to 400 ng/g (median: 20 ng/g). The log of the concentration of chlordane in river water was correlated with the log of the concentration in river sediment (correlation coefficient 0.53 when undetectable values were estimated at 0.2 ng/g, the limit of detection). The levels of chlordane were higher at points where the pollution of the stream from wastewater was apparent. (Rochester-PTT)
W89-10737

PESTICIDE RESIDUES IN DRINKING WATER IN THE NORTH COAST REGION OF NEW SOUTH WALES, AUSTRALIA, 1986-87,
New South Wales Dept. of Health, Lidcombe (Australia). Div. of Analytical Labs.
C. Ang, K. Meleady, and L. Wallace.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 595-602, April 1989. 1 fig, 2 tab, 9 ref.

Descriptors: *Australia, *Drinking water, *Pesticides, Fungicides, Chlorinated hydrocarbons, Wells, Reservoirs, Water tanks, Dieldrin, Propiconazole, Fungicides, Herbicides, Comparison studies.

Because of a history of significant pesticide usage of pesticides in the North Coast region of Australia, an survey was conducted to evaluate the extent of pesticide and herbicide residues in drinking water supplies. The results of a survey conducted from November 1986 to June 1987 in Coffs Harbour, Byron, Ballina, Lismore, and Tweed are reported here. In each local government area, samples were taken from the reticulated or public water supply system and from 20 private samples. Sites were selected to cover a range of exposure to pesticide usage and a variety of water source types including wells, dams, and roof water tanks. Each sample was analyzed for a range of herbicides and organochlorine and organophosphate pesticides and for the broad-spectrum fungicide propiconazole ('Tilt'). A total of 659 water samples were analyzed. Residues were not detected in 482 samples. Trace level residues were found in 147 samples and residues above trace levels were detected in 30 samples. Dieldrin was the residue most frequently detected in waters and comprised 63% of the results at or above trace levels (i.e., greater than 0.005 microgram/l in 151 samples). In three samples the levels were above the Australian maximum residue level; all were from the same private tank in Coffs Harbour. The high frequency of low levels of dieldrin detected in private water supplies is consistent with the extent of prior use of the chemical in the area. Compared to the private supplies, samples from the public water supplies were relatively free from residues. (Rochester-PTT)
W89-10738

HEAVY METALS IN BIVALVE MOLLUSCS IN THE HUELVA ESTUARY,
Instituto Nacional de Toxicologia, Seville (Spain).
M. Lopez-Artiguez, M. L. Soria, and M. Repetto.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 634-642, April 1989. 4 fig, 3 tab, 15 ref.

Descriptors: *Spain, *Molluscs, *Estuaries, *Heavy metals, *Path of pollutants, *Bioaccumulation, Copper, Tin, Chromium, Lead, Mercury, Cadmium, Arsenic, Tinto River, Odiel River, Rivers, Tissue analysis.

The levels of heavy metals in the Huelva Estuary (Atlantic Coast of Spain) were assessed by tissue analysis of molluscs. Three species of bivalve molluscs were used: clams (Tapes decussatus), oysters (Crassostrea angulata), and cockles (Cardium edule). All these species were taken in the mouth of the rivers Tinto and Odiel during January 1987. The range of concentration of Cu in clams was similar to that obtained during the period 1976-1977. The high Cu content in the oysters could be explained by the high copper contamination in this area and the great capacity of the oyster to accumulate this element. The concentrations of Hg observed in clams varied between 0.78 and 1.18, in the oysters between 0.02 and 0.90, and in cockles between 0.02 and 1.27 microgram/g. The amounts of Cd in the three species were higher than those in the literature. The values for As found the three species were 3.63-4.82, 1.18-2.07, and 1.31-1.89 microgram/g for clams, oysters, and cockles, respectively. Zinc was assayed only in oysters, with results of 296.04-651.16 microgram/g, which are similar to values obtained on the coast of Cadiz and the Strait of Gibraltar. Concentrations of Cr were particularly high in clams and cockles (0.71-0.94 microgram/g and 0.88-1.52 microgram/g, respectively). Values of lead were 0.15-0.25, 0.08-1.24, and 0.14-1.53 microgram/g for clams, oysters, and cockles, respectively. Values for tin were 2.07-9.07, 0.49-6.15, and 0.54-9.67 microgram/g for clams, oysters, and cockles, respectively. (Rochester-PTT)
W89-10742

REDUCTION OF ACID GENERATION IN MINE TAILINGS THROUGH THE USE OF MOISTURE-RETAINING COVER LAYERS AS OXYGEN BARRIERS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 5G.
W89-10744

INFLUENCE OF CHANGES IN METHANOL CONCENTRATION ON CLAY PARTICLE INTERACTIONS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
J. M. E. Storey, and J. J. Peirce.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 57-63, February 1989. 6 fig, 3 tab, 21 ref.

Descriptors: *Clays, *Liners, *Organic compounds, Hydraulic conductivity, Electrophoresis, Path of pollutants, Soil water, Soil properties, Methanol, Zeta potential, Atterberg limits, Suspended solids.

The interactions of clay particles with alcohol-water mixtures were investigated with hydraulic conductivity measurements, the electrophoretic mobilities of the suspended particles were measured, particle settling tests were carried out, and Atterberg limits were determined. Organic liquids frequently interact with clay particles in the clay liners of surface impoundments. Such fluids can cause changes in hydraulic conductivity of the liner material. This study looks at the effects of dilution of a liquid hydrocarbon with water on the properties of a clay soil. Tests with 20, 40, 60, 80, and 100% (by volume) methanol concentrations were used to investigate changes in hydraulic conductivity of water-compacted clay samples. Particle settling rates, Atterberg limits, and electrophoretic mobility studies were used with the same concentrations to determine the effects of changing methanol concentration on clay particle behavior. The results indicate that higher concentrations of methanol cause an increase in the attraction between the clay particles, and the same concentrations also cause an increase in hydraulic conductivity. Microelectrophoresis demonstrated that an increase in methanol concentration resulted in a decrease in the zeta potential of the suspended clay particles. This decrease indicates a possible decrease in the thickness of the double layer occurring at the 80 to 100% concentrations of methanol. Settling tests and Atterberg limits also showed that an increase in methanol concentration resulted in increased flocculation of the clay soil. The increase in hydraulic conductivity observed with 80-100% methanol corresponds to a decrease in double-layer thickness as indicated by the particle interaction tests. The differences in the properties of water-compacted clay and the dilute suspensions of clay particles, however, could be significant in relating particle interactions to hydraulic conductivity studies. (Author's abstract)
W89-10746

SULPHITE AND SULPHATE CONCENTRATIONS IN WEATHERING PRODUCTS OF SANDY LIMESTONE AND IN DEPOSITION SAMPLES,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
E. Roekens, C. Bleyen, and R. Van Grieken.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 289-298, 1989. 4 tab, 23 ref. Commission of the European Communities contract EV4V-0052-B (GDF).

Descriptors: *Water pollution sources, *Limestone, *Sulfates, *Belgium, *Path of pollutants, *Acid rain, *Weathering, Ion chromatography, Chemical reactions, Buildings, Calcite, Sulfates, Sulfites, Rain.

The sulfite and sulfate concentrations in weathering products of limestone and in wet and total deposition samples were measured by the West-Gaeke method and by ion chromatography. The sulfite content in the weathering crust and in the runoff rainwater of two historical buildings in Belgium always was much lower than the sulfate content (sulfite:sulfate ratio 0.025). The sulfite concentration in wet and total deposition samples was in the low or sub-ppm range except during two misty periods when the sulfite concentration was 6.8 and 21 mg/l. In those samples a high sulfate concentration also was found (nl. 57 and 137 mg/l, respectively). In view of the very low sulfite concentrations in the different samples, it seems that the transformation of SO2 to H2SO4 prior to the reaction with calcite is more important than the direct reaction of calcite with SO2, or that the intermediate CaSO3 is oxidized very quickly. Sulfite concentrations in rainwater are always in the low mg/L range or lower but it can be an important fraction of the total S content in rainwater. Sulfite is only barely detectable in warm summer months but in cooler winter months it can account for up to 13% of the total free acidity in the rain. (Rochester-PTT)
W89-10754

SEPARATE DISSOLVED AND PARTICULATE TRACE METAL BUDGETS FOR AN ESTUARINE SYSTEM: AN AID FOR MANAGEMENT DECISIONS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson, R. A. Feely, H. C. Curl, E. A. Crecelius, and G. P. Romberg.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 317-339, 1989. 4 fig, 5 tab, 50 ref, 2 append. DOE contract DE-ACOE76RLO-1830.

Descriptors: *Washington, *Water pollution sources, *Path of pollutants, *Heavy metals, *Trace metals, *Puget Sound, Cycling metals, Lead, Copper, Zinc, Management planning, Estuarine environment, Advection, Solute transport, Particulate matter.

The sources and sinks of dissolved and particulate Pb, Cu, and Zn were determined for the main basin of Puget Sound. Municipal, industrial, and atmospheric sources contributed about 66% of the total Pb added to the main basin of Puget Sound during the early 1980s. Advective inputs were the major sources of total Cu and Zn (approximately 40%), whereas riverine and erosional sources contributed about 30%. The discharge of the particle-bound trace metals from rivers minimized the influence of particulate anthropogenic sources, which constituted 50%, 23%, and 18% of the total particulate Pb, Cu, and Zn inputs, respectively. While advective transport was the major source of dissolved Cu and Zn (about 60% of all dissolved inputs), industrial, municipal, and atmospheric inputs contributed about 85%, 30%, and 38% of the dissolved Pb, Cu, and Zn inputs, respectively. The sources of dissolved and particulate Cu and Zn were comparable with the sinks within the errors of the analyses, indicating their quasi-conservative nature. Advection removed about 60% of the total Cu and Zn added to the main basin, whereas 40% was deposited in the sediments of Puget Sound. Because of this quasi-conservative nature of Cu and Zn, anthropogenic inputs of Cu and Zn were dispersed from the system more than they were contained within main basin sediments. About 75% of the dissolved Pb discharged into the main basin of Puget Sound was lost from the dissolved phase and was balanced by a similar gain in the particulate phase. Because of this extensive scavenging and the effective retention of particles within the main basin, about 70% of the total Pb added to the main basin was retained within its sediments. These separate mass balances are useful in management decisions because they show the relative contributions from different sources and demonstrate whether the influences of dissolved and particuiate inputs are reflected solely in the water column or the sediments, respectively. (Author's abstract)
W89-10756

PLASTIC PARTICLE AND TAR POLLUTION ON BEACHES OF KUWAIT,
Shiber Consultants, Safat (Kuwait).
J. G. Shiber.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 341-351, 1989. 2 fig, 1 tab, 33 ref.

Descriptors: *Kuwait, *Oil pollution, *Persian Gulf, *Water pollution sources, Path of pollutants, Oil tankers, Plastics, Tar, Weathering, Wind-driven currents.

Twelve beaches on the northwestern Arabian Gulf coast of Kuwait were surveyed for the occurrence of plastic particles, tar balls, and tar lumps. Particles were found on all beaches and were abundant on four: Suleikhat, Fintas, Fahaheel, and New Al Khiran. Most particles were composed of low-density polyethylene, but a few were of high-density polyethylene, polypropylene, and polystyrene. Many were weathered and had traces of tar. Tar lumps and balls were present on all beaches, but were not as abundant as expected, considering the heavy volume of oil tanker traffic in this region of the Arabian Gulf. Tar appeared to be less abundant than it was in 1979. With at least 33 plastics factories operating on the coast of Kuwait, it is possible that plastic particles occur more abundantly than was observed in this study. The high winds and concurrent wave activity, which often vary in strength and direction, but regularly occur here, probably play an important role in dispersing plastic particles, thus making accurate estimation of abundance difficult. (Author's abstract)
W89-10757

CONTROL BY ATMOSPHERIC PRESSURE PATTERNS OF SULPHATE CONCENTRATIONS IN PRECIPITATION AT ESKDALEMUIR, SCOTLAND,
University of East Anglia, Norwich (England). Climatic Research Unit.
G. Farmer, T. D. Davies, R. J. Barthelmie, P. M. Kelly, and P. Brimblecombe.
International Journal of Climatology IJCLEU, Vol. 9, No. 2, p 181-189, March/April 1989. 3 fig, 2 tab, 12 ref.

Descriptors: *Meteorology, *Climatology, *Scotland, *Acid rain, *Path of pollutants, Atmospheric pressure, Europe, Atlantic Ocean, Sulfates, Rainfall, Climates.

It is shown that, on a monthly basis, certain sea-level atmospheric pressure patterns can be identified that are conducive to, or mitigate against, high excess sulfate concentrations in the precipitation of Eskdalemuir, Scotland. This is not simply a consequence of the amount of precipitation influencing the concentration. The differences in the pressure patterns for months grouped into 'high' or 'low' excess sulfate concentration reflect the relative importance of transport for pollutant source regions and from regions with relatively small source strengths. It is the intensity of the pressure gradients over Europe and the Atlantic, combined with the position of the meridional axis of the Iceland Low/Azores High couplet that appears to influence the monthly excess sulfate concentration in precipitation. The existence of these relationships on a monthly time-scale points towards a climatic control on acidic deposition, and introduces a possible role for climatic change. (Author's abstract)
W89-10765

HEXAZINONE RESIDUES AND DISSIPATION IN SOIL LEACHATES,
Northern Forest Research Centre, Edmonton (Alberta).
J. C. Feng, S. S. Sidhu, C. C. Feng, and V. Servant.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24, No. 2, p 131-143, April 1989. 3 fig, 1 tab, 11 ref.

Descriptors: *Herbicides, *Path of pollutants, *Leachates, *Soil contamination, Hexazinone, Seasonal variation, Forests, Pronone 10G, Fate of pollutants.

Residues and dissipation of the herbicide hexazinone in soil leachate were determined under a 3-yr-old clear-cut forest after a 1986 fall application of Pronone 10G at 0, 2, and 4 kg ai/ha over a 448-day period. Soil leachates were collected at depths of 30, 55, and 80 cm and were analyzed individually for hexazinone (ai) residues. There was no soil leachate collected up to 112 days after application and before ground freeze. Leaching of hexazinone was triggered by the snow melt in spring 1987 and continued until the end of November 1987. Detected amounts of residues were the highest in the first postwinter collection, 227 days after treatment, reaching 205 and 61 microgram at 30 cm depth in the 4--and 2-kg ai/ha treatment plots, respectively, and reaching 89 and 39 microgram at 80 cm depth. At the 55 cm depth, the peaks were 178 microgram after 264 days and 28 microgram after 351 days in the 4- and 2-kg ai/ha treatment plots. Hexazinone residues declined to less than 17 microgram after 448 days in all depths and in both herbicide-treated plots. There were no hexazinone residues detected in the 0-treatment plot. The concentration of hexazinone in soil leachates was related inversely to the volume of leachate. The sample collected from the 4 kg ai/ha plot at a depth of 30 cm had the highest concentration (492 ppb), but the lowest volume (152 ml) 227 days after application, compared to samples collected at the same depth but at different times. In all cases the total amount of hexazinone residues (micrograms) in soil leachates increased with the rate of soil water percolation but declined over time. (Author's abstract)
W89-10766

LEVELS OF SELECTED PESTICIDES IN FARM DITCHES LEADING TO RIVERS IN THE LOWER MAINLAND OF BRITISH COLUMBIA,
Environmental Protection Service, West Vancouver (British Columbia). Pacific and Yukon Region.
M. T. Wan.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24, No. 2, p 183-203, April 1989. 6 fig, 2 tab, 16 ref.

Descriptors: *British Columbia, *Agricultural runoff, *Pesticides, *Path of pollutants, *Azinphosmethyl, *Diazinon, *Dinoseb, *Endosulfan, *Fensulfothion, Fraser River, Nicomekl River, Sumas River, Field ditches, Water pollution sources, Seasonal variation.

A monitoring survey was conducted from 1985 to 1987 to determine the levels of agricultural pesticides (azinophosmethyl, diazinon, dinoseb, endosulfan, and fensulfothion) in selected farm ditches leading to the lower Fraser, Nicomekl, and Sumas Rivers in British Columbia. In ditch water, azinphosmethyl, diazinon, endosulfan, and fensulfothion were not detected (limit of detection 1 microgram/l), but dinoseb was consistently found for 1 yr after the spray season at levels varying from 0.3-18.6 microgram/l (average 4.9 microgram/l). The endosulfan level in ditch water of one farm reached 1530 microgram/l shortly after a spray application, yet it was not found at other times of the year. In ditch sediments, 2.7, 4.0, 22.9, and 10.3 microgram/kg, respectively, of azinphosmethyl, diazinon, dinoseb, and fensulfothion were found sporadically. Endosulfan was found consistently at all study sites at levels varying from 2-150 microgram/kg (average 18.8 microgram/kg). (Author's abstract)
W89-10768

STRATEGIES FOR ASSESSING THE CUMULATIVE EFFECTS OF WETLAND ALTERATION ON WATER QUALITY,
East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W89-10776

DEPOSITION OF AIRBORNE NITROGEN AND PHOSPHORUS ON THE COASTAL ZONE AND COASTAL LAKES OF SOUTHERN BALTIC,

Gdansk Univ. (Poland). Inst. of Oceanography.
L. Falkowska, and K. Korzeniewski.

Polskie Archiwum Hydrobiologii PAHYA2, Vol. 35, No. 2, p 141-154, 1988. 2 fig, 11 tab, 21 ref.

Descriptors: *Atmospheric water, *Air circulation, *Nitrogen compounds, *Water pollution sources, *Nutrients, *Eutrophication, *Phosphorus compounds, *Chemistry of precipitation, *Seasonal variation, Water boundaries, Geohydrologic boundaries, Aerosols, Air-water interfaces, Air pollution, Ammonia, Air masses, Deposition, Chemical composition, Advection, Marine climates, Baltic Sea, Poland.

Studies were performed to determine the amount of atmospheric influx of nitrogen and phosphorus compounds in coastal lakes of the southern Baltic region during cold (November-April) and warm (May-October) seasons. Matter exchange in the upper and lower landscape boundaries, i.e., in the propagation range of aerosols and the surface water level, were examined. Aerosol and gas deposition was divided into wet and dry fractions. The results are summarized as follows: (1) concentrations of nitrogen and phosphorus compounds in the near-water layer of the atmosphere are very variable and depend on circulation of air masses; (2) increases in the concentration of nitrogen compounds in aerosols and ammonia and nitrogen dioxide in air, which was observed in winter, can be ascribed to seasonal increase in fuel utilization; (3) in the warm part of the year air masses travel over the Baltic region from westerly directions, and the amount of dry deposition of aerosols and gases depends mainly on their chemical composition; in the cold part of the year two types of advection--oceanic and continental--control the amount of deposition; (4) as compared to-1960, in 1981-1985 there was a tendency towards increase, particularlyitrogen, of the content of these compounds in rainfall over the Baltic area; (5) of the annual total of nitrogen and phosphorus input, dry deposition predominates over wet deposition; (6) the coastal zone of the southern Baltic region receives four kilograms of phosphorus and 1450 kilograms of nitrogen per square kilometer annually. (fish-PTT)
W89-10790

EFFECT OF INDUSTRIAL POLLUTION ON SEAFOOD CONTENT AND DIETARY INTAKE OF TOTAL AND METHYLMERCURY,

Zagreb Univ. (Yugoslavia). Inst. for Diabetes, Endocrinology and Metabolic Diseases.
R. Buzina, K. Suboticanec, J. Vukusic, J. Sapunar, and K. Antonic.

The Science of the Total Environment STENDL, Vol. 78, p 45-57, January 1989. 2 fig, 12 tab, 10 ref. Scientific Council of SR Croatia Grant 1.08.02. and World Health Organization Grant ICP/CWS 057-YUG 27.

Descriptors: *Mercury, *Methylmercury, *Industrial wastes, *Tolerance, *Path of pollutants, *Public health, *Adriatic Sea, *Water pollution effects, *Heavy metals, *Seafood, Fish.

The total mercury and methylmercury content of seafood was studied in an area of the Adriatic Sea polluted with inorganic mercury from a local industrial plant. The industrial pollution has affected both the total and the methylmercury content of seafood, but only the difference in the total mercury level was statistically significant when compared with a control area with no local industry. Studies of seafood consumption patterns indicate that, when the subjects examined from both areas were matched by their seafood consumption, both total mercury and methylmercury intake was higher in the industrially polluted area. The percentage of subjects ingesting total mercury above the World Health Organization Provisional Weekly Tolerance Intake (PWTI) of 300 micrograms was also higher in the industrially polluted area. However, the percentage of subjects whose methylmercury intake was above the PWTI of 200 micrograms was higher in the control area, primarily due to the increased number of subjects consuming fish more than five times per week. (Author's abstract)
W89-10795

PHOTOCHEMICAL CONVERSION OF CHLORINATED PHENOLIC SUBSTANCES IN AQUATIC MEDIA AS STUDIED BY AOX AND MICROTOX TESTS,

Swedish Environmental Research Inst., Stockholm.
A. Svenson, and L. Kaj.

The Science of the Total Environment STENDL, Vol. 78, p 89-98, January 1989. 2 fig, 3 tab, 18 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Photolysis, *Degradation, *Fate of pollutants, *Chlorinated hydrocarbons, *Phenols, *Photometry, *Testing procedures, *Toxicity, Adsorption, Light intensity, Organic compounds, Pollutant identification, Bioassay.

Six chlorophenolic substances were photochemically converted by illumination with xenon light. The adsorbable organic halogens (AOX) contents were determined after illumination for various periods. Pure chlorinated phenolic substances were readily detected by AOX. Both adsorbable and non-adsorbable chlorinated products were formed. Chloride analysis indicated that most, if not all, of the non-adsorbable products consisted of chloride ions. Microtox, a bacterial bioluminescence test, was used as a screening test for toxic properties of the photolysis products. Products from 2,4,6-trichlorophenol were more toxic than the original substance. Other compounds tested had less toxic products as measured by their combined effect on the Microtox system. Products ofdichlorophenol, 2,3,4-trichlorophenol, 4,5,6-trichloroguaiacol, and 2,3,4,5-tetrachlorophenol did not seem to contribute to the combined toxic properties after partial photolysis of the parent compound. Pentachlorophenol was converted into products which had substantial effects on the Microtox system. (Author's abstract)
W89-10797

HUMAN EXPOSURE TO ENVIRONMENTAL POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS: AN EXPOSURE COMMITMENT ASSESSMENT FOR 2,3,7,8-TCDD,

Lancaster Univ. (England). Dept. of Environmental Sciences.
K. C. Jones, and B. G. Bennett.

The Science of the Total Environment STENDL, Vol. 78, p 99-116, January 1989. 1 fig, 4 tab, 60 ref.

Descriptors: *Water pollution effects, *Body burden, *Chlorinated hydrocarbons, *Path of pollutants, *Population exposure, *Diets, Hazardous wastes, Incineration, Waste disposal, Environment.

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs and PCDFs) are released into the environment from the use of chemicals contaminated with PCDDs or PCDFs, the improper disposal of contaminated production wastes and incineration or other high-temperature processes. Certain congeners are extremely stable compounds which are persistent in the environment once released. An assessment was made of the sources of human exposure to one particular dioxin congener, 2,3,7,8-tetrachlorodibenzo-p-dioxin,7,8-TCDD). Representative values of 2,3,7,8-TCDD concentrations in the background environment and in man were selected from available data or, when not available, inferred from other relevant information. A pathway analysis was performed utilizing the exposure commitment method. Normal dietary intake of 2,3,7,8-TCDD is quite variable depending primarily on consumption of contaminated fish. Representative intake for the average adult of 0.1 nanograms per day may be associated with a human body burden of 100 nanograms (approximately 7 nanograms 2,3,7,8-TCDD per kilogram adipose tissue). The inferred biological half-time of this compound in the body is approximately five years. The exposure evaluation also accounts for secondary pathways to man of 2,3,7,8-TCDD in air and drinking water. Estimates of transfer factors obtained from the representative background levels should be generally relevant and may be applied to more specific cases of exposure. (Author's abstract)
W89-10798

ACCUMULATION OF ARSENIC IN YELLOWEYE MULLET (ALDRICHETTA FORSTERI) FOLLOWING ORAL ADMINISTRATION OF ORGANOARSENIC COMPOUNDS AND ARSENATE,

Western Australian Marine Research Labs., Perth.
K. A. Francesconi, J. S. Edmonds, and R. V. Stick.

The Science of the Total Environment STENDL, Vol. 79, No. 1, p 59-67, February 1989. 1 fig, 1 tab, 17 ref.

Descriptors: *Arsenic compounds, *Path of pollutants, *Fish, *Bioaccumulation, Fish diets, Organic compounds, Fish physiology, Mullet, Arsenicals, Food chains, Muscle, Testing procedures, Tissue analysis.

It is not known how marine animals accumulate arsenic compounds, although it has been shown that arsenobetaine is the sole or major arsenical found in a large range of marine animals, and that seawater is unlikely to be a significant source. Groups of yelloweye mullet (Aldrichetta forsteri) were maintained for several weeks on diets containing one of a range of organoarsenic compounds (arsenobetaine, arsenocholine, 2-dimethylarsinylethanol, 2-dimethylarsinylacetic acid, 2-dimethylarsinothioylethanol) or arsenate. Fish fed 2-dimethylarsinylethanol, 2-dimethylarsinylacetic acid of 2-dimethylarsinothioylethanol showed no increase in arsenic concentrations in their muscle tissue, while fish fed arsenate showed small increases. The two groups of fish which received either arsenobetaine or arsenocholine had greatly elevated arsenic concentrations in their muscle tissue resulting from an estimated 40% retention of ingested arsenic. Examination of the form of arsenic accumulated by fish fed arsenocholine showed that 89% of the arsenic was accumulated as arsenobetaine. (Author's abstract)
W89-10800

MUTAGENICITY AND ALKYLATING ACTIVITY OF THE AQUEOUS CHLORINATION PRODUCTS OF HUMIC ACID AND THEIR MOLECULAR WEIGHT FRACTIONS,

New York Univ. Medical Center, NY. Inst. of Environmental Medicine.

For primary bibliographic entry see Field 5F.
W89-10801

ROLE OF MACROPHYTES IN CYCLING OF HEAVY METALS IN WATER ECOSYSTEMS (ROLAMAKROFITOW W KRAZENIU METALI CIEZKICH W EKOSYSTEMACH WODNYCH),

Warsaw Univ. (Poland). Dept. of Hydrobiology.

For primary bibliographic entry see Field 5D.
W89-10803

BIOLOGICAL AND ABIOTIC DEGRADATION OF XENOBIOTIC COMPOUNDS IN IN VITRO ESTUARINE WATER AND SEDIMENT/WATER SYSTEMS,

Gulf Coast Research Lab., Ocean Springs, MS.
W. W. Walker, C. R. Cripe, P. H. Pritchard, and A. W. Bourquin.

Chemosphere CMSHAF, Vol. 17, No. 12, p 2255-2270, 1988. 3 fig, 2 tab, 47 ref. EPA Contract 68-01-5043; EPA Cooperative Agreements CR809797, CR809370.

Descriptors: *Estuaries, *Marine sediments, *Biodegradation, *Degradation, *Pesticides, *Fate of pollutants, Bioassay, Gas liquid chromatography.

First-order biotic and abiotic degradation rate constants of 14 pesticides were determined in estuarine water and sediment/water slurry systems. Test systems used environmentally realistic concentrations of pesticides in sterile and nonsterile samples of water and sediment taken directly from the field. Thiobencarb, sulprofos, chlorothalonil, diclofopmethyl, fenthion, oxyfluorfen, methoxychlor,

phorate, and trifluralin all showed significantly ($p < or = 0.01$) more degradation in the presence of nonsterile sediment than in the presence of sterile sediment. Most of these nine pesticides biodegraded significantly faster in flasks containing sediment than in those with water alone. Endosulfan and PCNB, however, biodegraded faster in the absence of sediment. EPN and chlorpyrifos were degraded primarily by abiotic processes. Methomyl did not significantly degrade under any test conditions. Oxyfluorfen and chlorpyrifos were also slow to degrade, with half-lives of generally more than two weeks in nonsterile sediment. Diclofop-methyl and phorate were the least persistent, with half-lives of a few days or less. (Author's abstract)
W89-10808

SPATIAL VARIATIONS AND CORRELATIONS IN THE DISTRIBUTION OF PCDDS, PCDFS AND RELATED COMPOUNDS IN SEDIMENTS FROM THE RIVER RHINE-WESTERN EUROPE,
Amsterdam Univ. (Netherlands). Lab. of Environmental and Toxicological Chemistry.
E. H. G. Evers, K. C. M. Ree, and K. Olie.
Chemosphere CMSHAF, Vol. 17, No. 12, p 2271-2288, 1988. 4 fig, 6 tab, 57 ref, append.

Descriptors: *Water pollution sources, *Path of pollutants, *Spatial distribution, *Dioxins, *Sediments, *Rhine River, Aromatic compounds, Fate of pollutants, Wastewater, Industrial wastewater, Contamination, Tributaries, Rivers.

PCDDs, PCDFs, and some related aromatic compounds were determined isomer-specifically in sediments from the river Rhine and its tributaries in order to study sources and environmental fate of these compounds. Additionally, wastewater effluents from industries that unintentionally might coproduce PCDDs or PCDFs were analyzed. In all sediments from the river Rhine and its tributaries, PCDDs and PCDFs could be detected in total concentrations varying from 0.2 ng/g in sediments from the upper part of the river to 18 ng/g dry weight in sediments from the industrialized lower lying part of the river. Expressed as summed toxic TCDD equivalents, the concentrations varied between 0.01 ng/kg and 310 ng/kg dry sediment. Results support the hypothesis that the pollution of the Dutch river Rhine sediments with PCDFs and PCBs originated from a source located along the Rhine between kilometer points 660.0 and 687. Four possible sources can be considered and should be studied in more detail: (1) unintentional formation of PCDFs and PCBs as byproduct from industrial processes located between the abovementioned Rhine kilometers; (2) incomplete incineration of PCB-containing wastes; (3) leakage from contaminated waste sites; (4) spills from PCBs still in use. The latter two possibilities were regarded to be very unlikely because these sources were neither found nor reported in the study area. (Doria-PTT)
W89-10809

BINDING OF THREE PCB CONGENERS TO DISSOLVED ORGANIC CARBON IN FRESHWATERS,
Toronto Univ. (Ontario). Dept. of Zoology.
H. E. Evans.
Chemosphere CMSHAF, Vol. 17, No. 12, p 2325-2338, 1988. 2 fig, 5 tab, 32 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Organic carbon, *Dissolved solids, *Sorption, Fate of pollutants, Lakes, Streams, Humic acids, Solubility, Ontario.

The binding of three polychlorinated biphenyl (PCB) congeners to natural levels of dissolved organic carbon (DOC) was measured in 12 lakes and streams in Ontario using Sep-Pak C18 columns. The association coefficients calculated on the basis of DOC (i.e., K sub DOC mL/g C), varied by more than an order of magnitude among the different freshwaters and ranged between 205 and 8,860 mL/g C for PCB 52 and 10,300 and 170,000 mL/g C for PCB 153. In general, there were no significant correlations ($p > 0.05$) between the K sub DOC values and various chemical parameters in the study lakes and streams. A relationship was derived between the fraction of bound PCB and the octanol-water partition coefficient. While this relationship explained almost 50% of the variation in the observed data, it is apparent that other factors influence K sub DOC values and that in natural freshwaters, only a small fraction of the DOC in involved in the binding of PCBs and other hydrophobic pollutants. (Author's abstract)
W89-10810

KINETICS OF THE UPTAKE AND ELIMINATION OF POLYCHLORINATED BIPHENYLS BY AN ESTUARINE FISH SPECIES (RHABDOSARGUS HOLUBI) AFTER AQUEOUS EXPOSURE,
Port Elizabeth Univ. (South Africa). Dept. of Oceanography.
A. C. De Kock, and D. A. Lord.
Chemosphere CMSHAF, Vol. 17, No. 12, p 2381-2390, 1988. 3 fig, 1 tab, 21 ref.

Descriptors: *Polychlorinated biphenyls, *Excretion, *Bioaccumulation, *Path of pollutants, *Estuaries, *Fish, Aroclors, Biological magnification, Fate of pollutants, Gas chromatography, Solubility, Molecular structure, Gills, Oxygen transfer.

A laboratory study was undertaken to determine the bioconcentration kinetics of the very lipophilic material Aroclor 1260 from water by a South African estuarine fish species, Rhabdosargus holubi. Results showed a rapid initial uptake by the fish with an almost linear increase of PCB concentration in the fish during the first 20 to 30 days of exposure. An indication of a plateau or equilibrium level is shown after about 90 days. The uptake rate constants and depuration rate constants were calculated from concentrations in fish sampled during the experiments. Using these data, bioconcentration factors (BCF) and the biological half-life for Aroclor 1260 were calculated. After 90 days of exposure, the BCF was 24,00 and the half-life 50 days. It is concluded that, for such lipophilic chemicals, the uptake rate becomes a function mainly of the ventilation rate and water concentration only, with membrane permeability no longer the limiting factor. Due to this very rapid uptake, even short exposures to high concentrations of such nonpolar materials as would occur during a chemical spill are as deleterious as longer periods of exposure to low concentrations. (Doria-PTT)
W89-10811

CONVENIENT TEST METHOD FOR PHOTOCHEMICAL TRANSFORMATION OF POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5A.
W89-10812

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: STEADY-STATE SOLUTIONS BY A FOURIER SINE TRANSFORM METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
A. Fogden, K. A. Landman, and L. R. White.
Applied Mathematical Modelling AMMODL, Vol. 13, No. 3, p 160-177, March 1989. 4 fig, 2 tab, 12 ref, 5 append.

Descriptors: *Fracture permeability, *Groundwater movement, *Solute transport, *Path of pollutants, *Geologic fractures, *Porous media, *Fourier analysis, Advection, Interfaces, Mathematical studies, Mathematical models, Boundary conditions, Groundwater pollution.

The steady-state transport of a decaying contaminant in a fractured porous rock matrix by two-dimensional diffusion and vertical advection is treated by a Fourier sine transform technique for the cases of a single vertical fracture and a periodic array of fractures. The general case of unequal Peclet numbers in the fracture and matrix regions is reduced to a first-kind Fredholm integral equation in the transformed interfacial flux. The asymptotic behavior of the solution for large and small vertical positions relative to the contaminant source is analyzed. For the special case of equal Peclet numbers, an exact analytical expression for the steady-state concentration has been derived for an arbitrary source distribution. A method of calculating an accurate analytical approximate solution to the general mismatched Peclet number case is proposed, and its accuracy verified by comparison of its predictions with the exact numerical solution obtained by a boundary integral method. (Author's abstract)
W89-10828

METHOD TO ESTIMATE DIFFUSE INFLOW OF FRESH WATER INTO A COASTAL SEA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
T. Legovic, and N. Limic.
Applied Mathematical Modelling AMMODL, Vol. 13, No. 4, p 242-247, April 1989. 3 fig, 7 ref.

Descriptors: *Influent water, *Coastal waters, *Path of pollutants, Bays, Adriatic Sea, Mathematical studies, Mathematical models, Tides, Water currents, Salinity, Estimating equations.

Coastal waters are more polluted, more eutrophic, and less saline than open waters due to inflow at sea level, below sea level, or at the bottom. Although this difference is often measured and discussed, a more difficult problem is to estimate the inflow of matter from various sources in coastal waters. Such cases arise when fresh water enters a bay at several unknown places in the form of springs at the bottom. A simple salt balance would not yield useful results, due to dominant tidal currents and, consequently, salinity variation in the gate. A method is presented to estimate the total inflow rate of a diffuse source of fresh water into a small bay. The method relies on an estimation of the residual current field and on measurements of salinity in the coastal sea. The method is applied to the estimation of freshwater inflow rate during summer into a small bay in the Adriatic Sea. With some modification, the method may be applied to the estimation of a pollutant or measurable chemical species in a coastal sea regardless of its conservative or nonconservative behavior. (Author's abstract)
W89-10829

COPPER IN THE FLY RIVER SYSTEM (PAPUA NEW GUINEA) AS INFLUENCED BY DISCHARGES OF MINE RESIDUE: OVERVIEW OF THE STUDY AND PRELIMINARY FINDINGS,
Institute for Soil Fertility, Haren (Netherlands).
W. Salomons, M. Eagle, E. Schwedhelm, E. Allersma, and J. Bril.
Environmental Technology Letters ETLEDB, Vol. 9, p 931-940, 1988. 7 fig, 3 tab, 5 ref.

Descriptors: *Copper, *Papua New Guinea, *Water pollution sources, *Mine wastes, Heavy metals, Sediment transport, Oxygen, Isotopic tracers, Hydrology, Geochemistry, Mixing, Gold, Suspended sediments.

An overview is presented of a study to quantify the impact of a gold-copper mine on the Fly River in Papua New Guinea. Copper concentrations have increased to several hundreds micrograms/g in the suspended matter but decrease downstream. The decrease is caused by admixture of nonpolluted sediments. Excellent agreement is found between mixing ratios determined from field surveys and from a natural tracer study. Laboratory and field measurement indicate that dissolved copper concentrations will decrease once gold production stops and only copper concentrate is produced. (Author's abstract)
W89-10832

PHOTOCHEMICAL EFFECTS ON THE MOBILITY AND FATE OF HEAVY METALS IN THE AQUATIC ENVIRONMENT,
Australian Nuclear Science and Technology Organisation, Sutherland.
T. D. Waite.
Environmental Technology Letters ETLEDB,

Vol. 9, p 977-982, 1988. 1 fig, 50 ref.

Descriptors: *Photoactivation, *Path of pollutants, *Heavy metals, *Aquatic environment, *Radiation, Reviews, Metal complexes, Copper, Cobalt, Arsenic, Tin, Chromium, Vanadium, Selenium, Uranium, Fate of pollutants, Catalysts.

While metals--particularly the multivalent transition metals--exhibit an active photochemistry, the breadth of investigation of light-initiated transformations involving metals in natural waters has been relatively limited. There has been considerable speculation regarding the possible catalytic role of semiconducting metal oxides in the transformation of both organic and inorganic species in natural waters and the ability of light to induce or enhance the dissolution of oxides of iron and manganese has been investigated by a number of workers. Major interest in the ability of light to alter the equilibrium speciation of iron and manganese has stemmed from their potential status as limiting nutrients to primary productivity in marine systems and their role as dominant scavenging phases in natural waters. A variety of other metals that might be expected to exhibit photoactivity under natural water conditions are discussed. Metals are grouped into those that are complexed (copper and cobalt), those that are alkylated (tin and arsenic), and those for which binding to oxygen is an important condition for photoactivity (chromium, vanadium, selenium, and uranium). (Author's abstract)
W89-10837

URANIUM IN HOLOCENE VALLEY-FILL SEDIMENTS, AND URANIUM, RADON, AND HELIUM IN WATERS, LAKE TAHOE-CARSON RANGE AREA, NEVADA AND CALIFORNIA, U.S.A.,
Geological Survey, Denver, CO. Branch of Sedimentary Processes.
J. K. Otton, R. A. Zielinski, and J. M. Been.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 15-28, January/February 1989. 12 fig, 4 tab, 28 ref.

Descriptors: *Water pollution sources, *Geochemistry, *Uranium, *Sediments, *Valleys, *Radon, *Helium, *Path of pollutants, Carson Range, Lake Tahoe, Peat, Sand, Silt, Mud, Fens, Marshes, Streams, Water pollution sources, Water pollution, Groundwater pollution, Water quality standards.

The uranium content of sediments in the Lake Tahoe-Carson Range area of Nevada and California approaches 0.6%; however, the average is in the range of 300-500 ppm. Waters associated with these sediments locally contain as much as 177 ppb uranium. Modest levels of helium and radon also occur in these waters. Uraniferous waters are clearly entering the private and public water supply systems in some parts of the study area; however, it is not known how much uranium is reaching users of these water supplies. Many of the waters sampled in the study area exceed the published health effects guidance level of the Environmental Protection Agency. Regulatory standards for uranium in waters have not been published, however. Much uranium is stored in the sediments along these stream valleys. Estimates for a marsh and a fen along one drainage are 24,000 and 15,000 kg, respectively. The potential effects of man-induced environmental changes on the uranium are uncertain. Laboratory studies of uraniferous sediment rich in organic matter may allow us to evaluate the potential of liberating uranium from such sediments and creating transient increases in the level of uranium moving in water in the natural environment. (Doria-PTT)
W89-10839

HEAVY METAL CONTENT IN THE STREAM SEDIMENTS ADJACENT TO A SANITARY LANDFILL,
Southwest Missouri State Univ., Springfield.
E. J. Mantei, and D. D. Coonrod.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 51-58, January/February 1989. 4 fig, 3 tab, 12 ref.

Descriptors: *Heavy metals, *Sediments, *Landfills, *Streams, *Path of pollutants, Sampling, Silver, Zinc, Copper, Cadmium, Lead, Atomic absorption spectroscopy, Hydrogen ion concentration, Statistical analysis.

Samples of stream sediments were collected along two streams adjacent to a sanitary landfill. One of the streams drained the landfill directly. In addition, control of background samples were also analyzed from a stream not affected by the landfill. All samples were analyzed for Ag, Zn, Cu, Cd, and Pb content using atomic adsorption techniques. The pH of the three streams were monitored since pH differences in the streams may affect the quantities of metals adsorbed or precipitated on the sediments. The comparison between the content of Ag, Zn, and Cu in the sediments of the two study streams and the same metals in the control sediments indicated the landfill emitted these metals into the two adjacent streams. However, since the Cd and Pb contents in the sediments of both streams were similar to that of the control stream sediments, these metals may not be emitted into the two study streams from the landfill and they represent only background quantities. The comparisons of each metal in the sediments of each stream were made by the use of a metal trend chart, the individual calculated mean metal content values, and by the statistical two sample t-test. No decreasing trends of the quantities of Ag, Zn, or Cu as a function of increasing distance from the landfill was present in the sediments along the stream that drained the landfill directly. These sediments might have been affected by stream action and became mixed with other sediments downstream. (Author's abstract)
W89-10843

TRACE ELEMENT MINERAL TRANSFORMATIONS ASSOCIATED WITH HYDRATION AND RECARBONATION OF RETORTED OIL SHALE,
University of Wyoming Research Corp., Laramie. Western Research Inst.
M. E. Essington.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 59-66, January/February 1989. 3 tab, 35 ref. US DOE Cooperative Agreement DE-FC21-83FE60177.

Descriptors: *Trace elements, *Geochemistry, *Oil shale, *Fate of pollutants, Industrial wastes, Nitric acid, Cobalt, Nickel, Zinc, Heavy metals, Antimony, Carbon dioxide, Vanadium, Chromium, Strontium, Barium, Manganese, Leaching.

A laboratory study was conducted to evaluate the influence of hydration and recarbonation on the solid-phase distribution of trace elements in retorted oil shale. Trace elements examined in this study were found to reside predominantly in the HNO3-extractable and residual fractions. Hydration of retorted oil shale resulted in a shift in the majority of trace elements from residual to extractable forms. Cobalt, nickel, and zinc extractabilities were not significantly influenced by hydration, whereas antimony increased in the residual fraction. Subjecting retorted oil shale to atmospheric (0.033%) and 10% CO2(g) levels over a nine-month equilibration period resulted in partial and full recarbonation, respectively. As the influence of recarbonation increased, trace elements reverted to residual forms. Vanadium, chromium, copper, zinc, antimony, and molybdenum in the 10% CO2(g) recarbonated material were more resistant to sequential extraction than in retorted oil shale, whereas strontium, barium, and manganese were less resistant to sequential extraction. The extractabilities of cobalt, nickel, and lead were not affected by recarbonation. A significant result of this study was that the mineralogical residencies of trace elements in retorted oil shale were altered in response to conditions that may be present in a disposal environment. Thus, the long-term release of trace elements in retorted oil shale disposal environments may not be adequately predicted by applying the toxicity characteristic leaching procedure (TCLP). (Author's abstract)
W89-10844

WATERSHED SURVEYS TO SUPPORT AN ASSESSMENT OF THE REGIONAL EFFECTS OF ACIDIC DEPOSITION ON SURFACE WATER CHEMISTRY,
Corvallis Environmental Research Lab., OR.
J. Lee, R. Church, D. Lammers, L. Liegel, and M. Johnson.
Environmental Management EMNGDC, Vol. 13, No. 1, p 95-108, January/February 1989. 4 fig, 5 tab, 28 ref. DOE Contract DE-AC05-840R214000.

Descriptors: *Watersheds, *Water chemistry, *Water pollution sources, *Hydrologic data collections, *Acid rain, *Chemical properties, *Surveys, *Surface water, Air pollution effects, Maps, Vegetation, Land use, Geology, Soil types, Soil properties, Quality control, Risk assessment, Environmental protection, Soil chemistry.

Through the Direct/Delayed Response Project (DDRP), the United States Environmental Protection Agency is attempting to assess the risk to surface waters from acidic deposition in three regions of the eastern United States. Because the needed terrestrial data base was not available, regional watershed surveys were conducted to meet the specific data needs of the DDRP. Maps (1:24,000) of soils, vegetation, land use, depth to bedrock, and bedrock geology were made for each watershed. The soils were grouped into sampling classes based on their hypothesized response to acidic deposition. Randomized sampling of these classes provided regional means and variances of soil properties that can be applied to individual watersheds. Because of DDRP's need for consistency within and among regions, unique quality control/quality assurance activities were developed and implemented. After verification and validation, the DDRP data base will be made publicly available. This will be a unique and useful resource for others investigating watershed relationships on a regional scale. The results of these surveys and the conclusions of the DDRP will be presented in several future papers. The current paper gives an overview of the context, rationale, logistical considerations, and implementation of these surveys, with special emphasis on the field activities of watershed mapping and soil sampling. This discussion should be useful to those planning, implementing, and managing survey activities in support of regional assessments of other environmental concerns, who are likely to face similar choices and constraints. (Author's abstract)
W89-10847

PRESENCE OF MERCURY IN CERTAIN PRODUCTS FROM THE SEAS AND LAGOONS OF TUNIS (SUR LA PRESENCE DE MERCURE DANS CERTAINS PRODUITS MARINS ET LAGUNAIRES DE TUNISIE),
M. Hadj Ali Selem, M. Belkhir, and H. Amara.
Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche BNSSEE, Vol. 13, p 5-12, 1986. 6 tab, 8 ref. English summary.

Descriptors: *Water pollution sources, *Bioaccumulation, *Mercury, *Heavy metals, *Tunisia, *Fish, Lakes, Shrimp, Mollusks, Tissue analysis, Pollutant identification.

The degree of mercury contamination of the coastal waters of Tunisia was investigated. Total mercury was analyzed in the tissues of coastal marine organisms such as: (1) Fishes, (2) Bivalves, (3) Shrimp, and (4) Cuttle-fish. Total mercury obtained varied from 29 +or-12 ppb to 198 +or-18 ppb for all the organisms gathered from the lake of Tunis, the lake of Bizerte, the Gulf of Tunis, the Gulf of Hammamet, and the Gulf of Gabes. These results are very low when compared to the tolerated concentrations fixed by the UN's Food and Agricultural Organization (FAO) of 500-1000 ppb mercury indicating that mercury levels in fish and seafood from Tunisian coastal water are not dangerous for human health. (Author's abstract)
W89-10851

INFLUENCE OF UREA TOP DRESSING OF FOREST WATER CATCHMENT AREAS ON THE BIOLOGICAL SUFFICIENCY AND WATER QUALITY OF MOUNTAIN STREAMS. II. COMPOSITION, ABUNDANCE AND

STRUCTURE OF THE BENTHIC COMMUNITIES (VLIYANIE NA TORENETO C UREYA NA GORSKI VODOSBARI VERKHI BIOLOGICHNATE P'LNOTSENNOST I KACHESVATA NA VODITE V PLANINSKI POTOTSI. II. SISTAV, OBILIE I STRUKTURA NA D'NNITE S'OBSHCHESTVA),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
Y. I. Uzunov, and S. G. Kovachev.
Hydrobiology HYDRB8, Vol. 28, p 46-60, 1986. 4 fig, 4 tab, 6 ref. English summary.

Descriptors: *Water pollution sources, *Water pollution effects, *Forest watersheds, *Mountain streams, *Ureas, *Species diversity, *Yadenitsa River, Benthos, Catchment areas, Fertilizers, Nonpoint pollution sources, Bulgaria.

Mountain streams of the tributary system of the Yadenitsa River in Bulgaria were studied from April 1982 to October 1983 to determine the effects of experimental aerial top dressing with urea on forest catchment areas (600 kg/ha). The changes in the composition, abundance and structure of the macrozoobenthic communities were assessed. No clearly expressed toxic effect was observed but from the viewpoint of the assessment some unfavorable, though insignificant, ecological effects were seen in relation to the macrozoobenthos structure: its species diversity decreased while the level of domination increases. For these reasons, urea top dressing of forest water catchment areas is assumed to have a specific nonpoint impact on the benthic communities in mountain streams, since the natural zoobenthic structure was changed. It was shown that top dressing interferes with such important abiotic factors as the thermal, hydrological and oxygen water regimes. A lowering of the fertilizing norms is recommended for urea top dressing of forest water catchment areas with a view to reaching a level that will not have a negative effect on the structural organization of the natural stream communities. (Author's abstract)
W89-10856

STIGOBIOLOGICAL CHARACTERISTICS OF THE ALLUVIAL AND PLIOCENE WATERS IN THE DISTRICT OF JAMBOL (STIGOBIOLOGICHNA KHARAKTERISTICKA NA ALUVIALIN I PLIOTSENSKI VODI V YAMBOLSVI OKR'G),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
A. A. Petrova, E. B. Angelkova, R. L. Cvetkova, and D. A. Bokurestliev.
Hydrobiology HYDRB8, Vol. 28, p 66-83, 1986. 4 fig, 7 tab, 19 ref. English summary.

Descriptors: *Groundwater pollution, *Water pollution sources, *Agricultural chemicals, Humic acids, *Tundza River, Bulgaria, Industrial wastes, Water pollution control.

Groundwater in the Jambol and Elhovo valleys in Bulgaria are strongly affected by anthropogenic pollution sources. The transport of organic substance is primarily through the soil, but the influence of the contaminated waters of the Tundza River in the area Okop-Hanova-Tenevo was also established. The large quantity of organic substances in the groundwater is maintained not only by contamination processes, but also by humic substances which are widely spread in the soils of the region. A new index was developed--Id (index of degradation)--which reveals the relationship between the dissolved and suspended organic carbon and permits the dynamics of the degradation of organic substance in groundwater to be followed. The Id showed a weak degradation process. The unfavorable hydrogeological characteristics of the region, and the industrial and agricultural activities which center mainly across the terrace of the Tundza River have a negative effect on the qualitites of the ground-and Pliocene waters. This situation raises questions of a practical nature related to the uncontrolled fertilization of water catchment areas and the necessity for control over the sources of groundwater that are not protected from surface influence. (Author's abstract)
W89-10857

STUDY OF TOXIC COMPOUNDS IN RIVER BOTTOMS AT METROPOLITAN AREAS,
Indianapolis Public Works Dept., IN.
V. Keramida, T. Renner, and B. Neilson.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 7-17, 12 fig, 12 tab, 5 ref.

Descriptors: *Path of pollutants, *Toxicity, *Toxic wastes, *Heavy metals, *Sediment contamination, Indianapolis, Arsenic, Aluminum, Lead, Calcium, Chromium, Copper, Mercury, Manganese, Zinc.

The specific objective of this sediment sampling study was to determine the extent of the contamination of Fall Creek and White River throughout the metropolitan Indianapolis area. This study primarily focuses on contamination due to inorganic compounds found on the bottom sediment. The field work performed in the project was designed to discover any potential sediment 'hot spots' due to high trace metal concentrations. As such, the sediments could be used as indicators of prior or persistent pollution and thereby be used to locate specific problem areas. The samples were analyzed for aluminum, arsenic, barium, cadmium, chromium, copper, mercury, manganese, lead, and zinc using US Geological Survey laboratory analytical techniques. No significant increase or decrease pattern was observed in the concentration of any of the toxic pollutants at any sampling location over the five-year study period. An exception to this was lead, where a definite downward trend was observed at every sampling site, probably due to the decreased use of leaded gasoline over the study period. Time trends, hot spots, and comparisons of urban versus non-urban locations showed that, with few exceptions, each pollutant exhibited a unique, unpredictable pattern. (See also W89-10858) (Lantz-PTT)
W89-10860

EFFECT OF BACTERIA ADDITION ON BIODEGRADATION OF TOLUENE IN SUBSURFACE SOILS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-10868

SORPTION PROCESSES OF BENTONITE WITH LIQUID ORGANICS,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
A. M. Rodrigo, and P. C. Chan.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 115-121, 8 fig, 5 tab, 7 ref.

Descriptors: *Bentonite, *Sorption, *Organic compounds, *Path of pollutants, Soil contamination, Groundwater pollution, Solute transport, Chemical properties, Soil properties, Kinetics, Clays, Mathematical studies, Fate of pollutants.

Studies have been performed extensively on the migration of toxic and hazardous wastes in soils and groundwater systems in order to identify the factors affecting the movement of these substances. The transport and fate of these contaminants in groundwater systems are found to be dependent upon the chemical and biological reactions including binding rate, capacity and strength of pollutants to soil particulates. The binding of contaminants may be through the ion exchange reactions, adsorption or precipitation of them onto soil particles. The sorption characteristics of contaminants are governed by the material properties as well as the environment factors. The kinetic rates of sorption are dependent upon the nature of the contaminant. Less soluble (i.e., more hydrophobic) compounds bind to clay particles at a faster rate compared to that of high soluble compounds (i.e., hydrophilic). The sorption of non-ionic organic compounds onto bentonite can be best depicted by linear isotherms. The empirical equations used to estimate soil water partitioning coefficient, in terms of aqueous solubility or octanol-water partition coefficient can also be used to predict the equilibrium adsorption capacities of bentonite. The predicted maximum sorption capacities for bentonite using Langmuir isotherm is found to be best correlated to the dipole moment of the liquid organic (i.e., the maximum sorption capacity increases with the dipole moment). The sorption processes for bentonite are partially reversible. The ratio of organic retained in the soil to that initially adsorbed is constant and depends only upon the aqueous solubility of the organic pollutant. (See also W89-10858) (Lantz-PTT)
W89-10874

LONG-TERM COMPATIBILITY STUDY OF A TREATED BENTONITE/SOIL LINER WITH A HEAVY METAL SLUDGE,
American Colloid Co., Arlington Heights, IL. Environmental Products Div.
J. T. Olsta.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 137-140, 2 fig, 6 ref.

Descriptors: *Waste disposal, *Path of pollutants, *Bentonite, *Linings, *Landfills, Leachates, Permeability, Hydraulic conductivity, Heavy metals.

In 1975, a large chemical company in the Northeast United States chose American Colloid Company's contaminant-resistant treated bentonite as part of a double liner system for their proposed industrial landfill. The chemical company requested that American Colloid Company set up a laboratory permeability column to simulate the landfill. The column was to be maintained for the active life of the landfill. A column was set up with the actual industrial waste sludge and has been tested for over ten years. Actual sludge waste from the chemical company's manufacturing facility consisted primarily of hydroxide complexes of lead, chromium, cadmium, zinc, copper, iron and mercury. The waste material itself had a hydraulic conductivity of 1 micro-centimeter/sec. Leachate from the material was determined to be fairly corrosive. A Pyrex rigid-wall permeameter column was set up with native soil from the chemical company's proposed landfill area mixed with 3.5 lbs/sq ft of Saline Seal 100 and compacted in a two 2-inch lifts in the bottom section. A section containing the waste sludge was then imposed over the 4-inch seal. The study, covering 11 yrs and 5 months, indicated a range of hydraulic conductivities of the contaminant-resistant treated bentonite/soil seal of between 4.9 nano-cm/sec and 4.8 times 10 to the -8th cm/sec. (See also W89-10858) (Lantz-PTT)
W89-10876

CHARACTERIZATION AND EVALUATION OF ENVIRONMENTAL HAZARDS IN A LARGE METROPOLITAN LANDFILL,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5A.
W89-10878

PHYSICAL AND CHEMICAL CHARACTERISTICS OF UNSATURATED PORE WATER AND LEACHATE AT A DRY FLY ASH DISPOSAL SITE,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. L. Theis, J. A. Ripp, and J. F. Villaume.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 161-172, 14 fig, 4 tab, 5 ref.

Descriptors: *Waste disposal, *Fly ash, *Interstitial water, *Path of pollutants, Leachates, Infiltration, Capillarity, Evapotranspiration, Groundwater movement, Calcium, Potassium, Sodium, Magnesium, Sulfates, Hydrogen ion concentration, Trace metals.

The vertical properties of the fly ash with respect to water movement are not uniform. The migration of water down a test cell during infiltration is relatively fast, however, the top layers show a

much greater positive moisture gradient than lower levels. The redistribution of moisture within the cell after the end of the infiltration is a function of evapotranspiration, capillarity, and gravity drainage. Present data suggest that gravity plays a dominant role in the redistribution process. Meteorologic conditions at the site are such that the moisture distribution within the cell is not able to return to pre-storm conditions. The moisture movement is in a continual state of change. Seasonal influences appear to affect the depth of infiltration and hence the degree of saturation and generation of leachate. Inner cell pore water composition is dominated by strong base cations (Ca, Na, K, Mg) and sulfate ion. With the exception of calcium, these ions appear to gradually be exported from the cell. pH appears to be controlled by a combination of pore water chemical composition, particulate oxides, and, for shallow depths, moisture content of the material. Trace cation (Cd, Cu, Mn, Ni, Zn) and trace anion (Cr, Mo, Se) concentrations show strong inverse and direct correlations, respectively, with pore water pH. (See also W89-10858) (Lantz-PTT)
W89-10880

VARIABILITY OF FERROUS FOUNDRY WASTE LEACHING CHARACTERISTICS AND COMPARISON TO LANDFILL UNSATURATED ZONE LEACHATE QUALITY,
RMT, Inc., Madison, WI.
R. C. Krueger, R. K. Ham, and W. C. Boyle.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 605-616, 1 fig, 4 tab, 13 ref.

Descriptors: *Industrial wastewater, *Path of pollutants, *Leachates, *Metal-finishing wastes, *Statistical analysis, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Zinc, Phenols, Fluorine, Cyanide, Analysis of variance, Landfills.

Detailed leach testing of wastes from one ferrous foundry (Foundry D2) includes a components of variance analysis to estimate the variances associated with sample handling and laboratory analytical procedures, as well as several other statistical methods to estimate the mean concentrations and variations about the means of 10 chemical parameters (cadmium, chromium, copper, iron, lead, manganese, zinc, phenol, fluorine, and cyanide). Comparisons between the previously obtained landfill leachate results to the laboratory batch leaching test results from wastes from this foundry are conducted by means of probability plots. Phase I methods were conducted to estimate the variability of the laboratory analytical procedures and the variability of the laboratory riffling and leaching procedures. The experimental design used in Phase I was a components of variance statistical design. Phase II methods were conducted to estimate the temporal variability of each of three waste sources by sampling on randomly chosen days over a two-month period. For the chemical parameters evaluated during Phase I, the laboratory sample handling, leaching, and analytical procedures produced approximately 50% coefficient of variation. For the 10 chemical parameters investigated during the two-month (Phase II sampling period, there was nearly equivalent temporal variability within each of the three waste sources as evaluated by the two leach tests. Generally, the foundry process variability affected the baghouse dust, core butts, and system sand wastes to the same extent. The analysis of variance results indicated that more Fe, Mn, Zn and phenol was leached from baghouse dust samples than from core butts or system sand samples, and the EP leaching procedure extracted more of these parameters from the baghouse dust samples than did the water leaching procedure. The analysis of variance results also indicated that more cyanide and fluoride was leached from the baghouse dust samples, but the two leaching procedures were comparable for extracting these parameters. Most analyses for cadmium, chromium, and lead were below the analytical detection limits. (See also W89-10858) (Lantz-PTT)
W89-10923

POLLUTION CONTROL PROGRAM FOR THE 'TASTE OF CHICAGO' LAKEFRONT FESTIVAL,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5D.
W89-10936

WATER QUALITY OF NORTH CAROLINA STREAMS.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2185 A-D, 1982. 120p.

Descriptors: *Water quality, *North Carolina, *Streams, *Rivers, *Baseline studies, Monitoring, Water pollution effects, Surveys, French Broad River, Neuse River.

In 1972, the US Geological Survey (USGS) devised a study to make a detailed accounting of water quality in the large rivers of North Carolina at key locations. The three major goals of the Large Rivers Study are: definition of variation in water quality; determination of pollution loads in streams; and determination of trends in water quality. This series of documents includes all of the reports produced in the Large Rivers Study in the sequence that they were written. In this volume, Chapter A describes in detail the initial design and philosophy of the USGS water quality program in North Carolina. Specific methodologies for the estimation of baseline water quality, pollution, and the evaluation of trends in water quality discussed in Chapter A are applied and refined in subsequent chapters that present water quality assessments of individual large rivers. Chapter B elaborates on the methodology used in estimating baseline water quality, and presents the results of a statewide baseline survey. Chapter C presents water quality assessments of the French Broad River, while Chapter D presents water quality assessments of the Neuse River. (See W89-10943 thru W89-10947) (Lantz-PTT)
W89-10942

PROGRAM FOR EVALUATING STREAM QUALITY IN NORTH CAROLINA,
Geological Survey, Raleigh, NC.
H. B. Wilder, and C. E. Simmons.
IN: Water Quality of North Carolina Streams, USGS Water-Supply Paper 2185 A-D, 1982. p A1-A15, 13 fig, 3 tab, 16 ref.

Descriptors: * Network design, *Water quality trends, *North Carolina, *Streams, *Water pollution sources, Rivers, Streamflow, Pollutant load, Project planning, Data acquisition.

The design and objectives of the program for evaluating stream quality in North Carolina are described. Using water quality and streamflow data collected since the 1940's, a study is underway to define certain variations in water quality, to quantify the effects of man's activities on water quality, and to determine long-term trends at key locations on the State's major rivers. Data collected from 47 unpolluted stream sites were used to estimate average concentrations for naturally occurring constituents during periods of high and low flow. Of the several methods for determining trends in water quality, the most reasonable results have been obtained using comparisons of water quality with discharge coupled with statistical tests of significance. Another method for detecting changes involves plotting dissolved-solids load versus stream discharge but this method is more complex because it requires the prior computation of daily loads. (See also W89-10942) (Lantz-PTT)
W89-10943

WATER-QUALITY CHARACTERISTICS OF STREAMS IN FORESTED AND RURAL AREAS OF NORTH CAROLINA,
Geological Survey, Raleigh, NC. Water Resources Div.
C. E. Simmons, and R. C. Heath.
IN: Water Quality of North Carolina Streams, USGS Water-Supply Paper 2185 A-D, 1982. p B1-B33, 15 fig, 6 tab, 15 ref.

Descriptors: *Forest watersheds, *Agricultural watersheds, *Streams, *Agricultural runoff, *Water pollution sources, *North Carolina, Phosphorus, Farm wastes, Stream runoff, Data collections, Chemical analysis.

From late 1973 through 1978 water quality samples were collected from a statewide network of rural stream sites. Data obtained from 39 sites, whose basins are 90% to 100% forested, were used to define unpolluted or baseline conditions. Data from 20 other sites believed to be affected by farming activities were used for comparison with data from the 39 forested sites to determine the increase in constituent levels caused by man. Data from these forested basins indicate wide areal variations in concentrations of many constituents. Significant increases in concentrations of major dissolved constituents and nutrients occurred at most of the 20 sites affected by farming activities. In basins where farm activities accounted for 20 or more percent of total land use, phosphorus levels during storm runoff were 2 to 13 times greater than from forested basins. Concentrations of minor elements were essentially the same in both forested and developed basins. (See also W89-10942) (Lantz-PTT)
W89-10944

WATER QUALITY OF THE FRENCH BROAD RIVER, NORTH CAROLINA--AN ANALYSIS OF DATA COLLECTED AT MARSHALL, 1958-77,
Geological Survey, Raleigh, NC. Water Resources Div.
C. C. Daniel, H. B. Wilder, and M. S. Weiner.
IN: Water Quality Water of North Carolina, USGS Water-Supply Paper 2185 A-D, 1982. p C1-C28, 15 fig, 14 tab, 19 ref.

Descriptors: *Water pollution sources, *French Broad River, *Pollutant identification, *Water quality, *North Carolina, Water quality control, Drinking water, Bacteria, Sodium, Sulfates, Calcium, Wastewater treatment, Dissolved oxygen, Chromium, Lead, Selenium, Zinc, Color, Chemical analysis.

An investigation of water quality in the French Broad River in North Carolina has resulted in the definition of variations in water quality, a determination of the degree to which the quality of water in the river has been affected by man's activities, and an analysis of trends in the changing chemical quality of the river. The investigation centered on data collected during 1958-77 at the U.S. Geological Survey's station at Marshall, N.C. The quality of water in the French Broad River at Marshall is suitable for most uses. None of the major dissolved constituents and nutrients, nor defined properties such as hardness, alkalinity and color, exceed suggested limits for drinking waters. Chromium, lead, selenium, and zinc are the only trace metals to occasionally exceed drinking water standards. Dissolved oxygen levels are high year round, remaining near or above the saturation level even at higher summer temperatures. Results of tests for biological oxygen demand and chemical oxygen demand characterize the French Broad at Marshall as a clean river. However, 58% of samples analyzed for fecal coliform bacteria during 1974-77 exceeded recommended limits for bathing waters. In 1958, an estimated 64% of the dissolved solids load in the river at Marshall was due to pollution. By 1966, 74% of the dissolved load could be attributed to pollution. Loads of dissolved solids, sodium, sulfate, and calcium showed the most dramatic increases, coinciding with general increases in population and industrial employment. New wastewater treatment facilities and improved industrial technology have apparently combined to curb pollution and reverse the earlier trend. In 1977 water quality had returned at least to levels of 1958. (See also W89-10942) (Lantz-PTT)
W89-10945

WATER QUALITY OF THE NEUSE RIVER, NORTH CAROLINA-VARIABILITY, POLLUTION LOADS, AND LONG-TERM TRENDS,
Geological Survey, Raleigh, NC. Water Resources

Div.
D. A. Harned.
IN: Water Quality of North Carolina Streams, USGS Water-Supply Paper 2185 A-D, 1982. p D1-D44, 34 fig, 15 tab, 34 ref.

Descriptors: *Water quality trends, *Water pollution sources, *Neuse River, *Pollutant identification, *North Carolina, Dissolved oxygen, Iron, Manganese, Cadmium, Lead, Nutrients, Algae, Organic carbon, Drinking water, Wastewater treatment, Pollutant load, Potassium, Sulfates.

Interpretation of water quality data collected by the U.S. Geological Survey for the Neuse River, North Carolina, has identified water quality variations, characterized the current condition of the river in reference to water quality standards, estimated the degree of pollution caused by man, and evaluated long-term trends in concentrations of major dissolved constituents. Overall, the water quality of the Neuse River is satisfactory for most uses. However, dissolved oxygen, iron, and manganese concentrations, pH, and bacterial concentrations often reach undesirable levels. Concentrations of cadmium, and lead also periodically peak at or above criterion levels for domestic water supply sources. Nutrient levels are generally high enough to allow rich algal growth. Changes in algal dominance, from genera usually associated with organically enriched waters to genera that are less tolerant to organic enrichment, indicate improvement in water quality of the Neuse since 1973. These changes, along with a reduction in total organic carbon concentrations, coincide with activation in 1976 of a new wastewater treatment plant for the Raleigh metropolitan area. Although little change since 1956 can be seen in many constituents, increases of over 50% are shown for potassium and sulfate concentrations. These long-term rises indicate the increasing impact that man has had on the Neuse River, in spite of improved wastewater treatment in the basin. (See also W89-10942) (Lantz-PTT)
W89-10946

WATER QUALITY OF THE YADKIN-PEE DEE RIVER SYSTEM, NORTH CAROLINA-VARIABILITY, POLLUTION LOADS, AND LONG TERM TRENDS,
Geological Survey, Raleigh, NC. Water Resources Div.
D. Harned, and D. Meyer.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. IN: Water Quality of North Carolina Streams, Chapter E. USGS Water-Supply Paper 2185-E, 1983. 71p, 43 fig, 22 tab, 58 ref.

Descriptors: *Water pollution sources, *Water quality trends, *Yadkin-Pee Dee River, *North Carolina, Chemical analysis, Pollutant load, Iron, Manganese, Lead, Hydrogen ion concentration, Dissolved oxygen, Suspended sediments, Nutrients, Ammonia, Phosphorus, Pollutant identification.

Interpretation of water quality data collected by the U.S. Geological Survey and the North Carolina Department of Natural Resources and Community Development, for the Yadkin-Pee Dee River system, has identified water quality variations, characterized the current condition of the river in reference to water quality standards, estimated the degree of pollution caused by man, and evaluated long-term trends in concentrations of major dissolved constituents. Three stations, Yadkin River at Yadkin College (02116500), Rocky River near Norwood (02126000), and Pee Dee River near Rockingham (02129000) have been sampled over different periods of time beginning in 1906. Overall, the ambient water quality of the Yadkin-Pee Dee River system is satisfactory for most water uses. Iron and manganese concentrations are often above desirable levels, but they are not unusually high in comparison to other North Carolina streams. Lead concentrations also periodically rise above the recommended criterion for domestic water use. Mercury concentrations frequently exceed, and pH levels fall below, the recommended criteria for protection of aquatic life. Dissolved oxygen levels, while generally good, are lowest at the Pee Dee near Rockingham, due to the station's location not far downstream from a lake. Suspended sediment is the most significant water quality problem of the Yadkin-Pee Dee River. The major cation in the river is sodium and the major anions are bicarbonate and carbonate. Eutrophication is currently a problem in the Yadkin-Pee Dee, particularly in High Rock Lake. An estimated nutrient and sediment balance of the system indicates that lakes along the Yadkin-Pee Dee River serve as a sink for sediment, ammonia, and phosphorus. Pollution makes up approximately 59% of the total dissolved solids load of the Yadkin River at Yadkin College, 43% for the Rocky River near Norwood, and 29% for the Pee Dee River near Rockingham. Statistically significant trends show a pattern of increasing concentration of most dissolved constituents over time, with a leveling off and decline in the middle to late 1970's. (See also W89-10942) (Lantz-PTT)
W89-10947

HYDROLOGY AND ECOLOGY OF THE APALACHICOLA RIVER, FLORIDA: A SUMMARY OF THE RIVER QUALITY ASSESSMENT,
Geological Survey, Raleigh, NC. Water Resources Div.
J. F. Elder, S. D. Flagg, and H. C. Mattraw.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2196-D, 1988. 46p, 22 fig, 48 ref.

Descriptors: *Dam effects, *Water pollution sources, *Hydrological regime, *Apalachicola River, *Water quality, *Florida, Ecosystems, Nutrients, Surface-groundwater relations, Rainfall, Organic matter, Flooding, River beds.

During 1979-81, the U.S. Geological Survey conducted a large-scale study of the Apalachicola River in northwest Florida, the largest and one of the most economically important rivers in the State. The study emphasized interrelations among hydrodynamics, the flood-plain forest, and the nutrient-detritus flow through the river system to the estuary. Data on accumulation of toxic substances in sediments and benthic organisms in the river were also collected. Water and nutrient budgets based on data collected during the river assessment study indicate the relative importance of various inputs and outflows in the system. Waterflow is controlled primarily by rainfall in upstream watersheds and is not greatly affected by local precipitation, groundwater exchanges, or evapotranspiration in the basin. On an annual basis, the total nutrient inflow to the system is nearly equal in quantity to total outflow, but there is a difference between inflow and outflow in the chemical and physical forms in which the nutrients are carried. The flood plain tends to be a net importer of soluble inorganic nutrients and a net exporter of particulate organic material. Analysis of long-term records shows that dam construction in the upstream watersheds and at the Apalachicola headwaters has had little effect on the total annual waterflow but has probably suppressed low flow extremes. Other effects include riverbed degradation and channelization which have to do with alteration of the habitat for aquatic biota and changes in floodplain vegetation. Flooding is crucial to the present floodplain plant community and to the production, decomposition, and transport of organic material from that community. Permanent, substantial changes in the natural flooding cycle would be likely to induce concomitant changes in the floodplain environment and in the nutrient and detritus yield to the estuary. (Lantz-PTT)
W89-10948

CHLOROFORM CONTAMINATION IN PART OF THE ALLUVIAL AQUIFER, SOUTHWEST LOUISVILLE, KENTUCKY,
R. W. Davis, and E. W. Matthews.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2202, 1983. 25p, 20 fig, 3 tab, 4 ref.

Descriptors: *Kentucky, *Chloroform, *Alluvial aquifers, *Groundwater pollution, *Water pollution sources, *Ohio River, Well water, Aeration zone, Carbon tetrachloride, Seasonal variation, Path of pollutants.

A well in the Ohio River alluvium at Louisville, Ky., has been yielding water with chloroform concentrations as high as 34.80 mg/L since July 1975. A spill of 5,000 gallons of chloroform in 1970, 120 ft from the well, is probably the source of the contamination. The chloroform is adsorbed in the unsaturated zone in the alluvium; the greatest concentrations are presently at and slightly above the water table. Lesser amounts of carbon tetrachloride are found with the chloroform. Its source is unknown. The two contaminants were above the water table in the alluvium until a long-term trend of rising groundwater levels caused water to reach the contaminants and the water-chloroform mixture began moving downgradient to the well. High river stages cause a seasonal cycle of water level rise, generally in late spring and midsummer; the groundwater comes in contact with more chloroform, and the chloroform concentration of the well water increases. No carbon tetrachloride has been observed in the well water. (Author's abstract)
W89-10950

PRELIMINARY EVALUATION OF GROUNDWATER CONTAMINATION BY COAL-TAR DERIVATIVES, ST. LOUIS PARK AREA, MINNESOTA,
Geological Survey, St. Paul, MN.
M. F. Hult, and M. E. Schoenberg.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2211, 1984. 53p, 18 fig, 4 tab, 6 plates, 40 ref.

Descriptors: *Groundwater pollution, *Coal tar, *Minnesota, *Path of pollutants, Groundwater movement, Water pollution sources, Industrial wastewater, Prairie du Chien-Jordan Aquifer, Organic compounds, Platteville Aquifer, Leaching, Aquifer.

Operation of a coal-tar distillation and wood-preserving plant from 1918 to 1972 in St. Louis Park, MN, resulted in groundwater contamination. By 1932, water in the Prairie du Chien-Jordan aquifer, the region's major source of groundwater, was contaminated 3,500 ft from the plant. It seems that this early contamination of the aquifer resulted in part from the introduction of coal-tar directly into a multi-aquifer well on the plant site. The aquifer characteristics, the long contamination history, and seasonal potentiometric surface fluctuations owing to heavy municipal and industrial withdrawals, combined to create a complex distribution of coal-tar derivatives in the Prairie du Chien-Jordan aquifer. In addition, at least 25 ungrouted or partly cased wells in the area may permit contaminated water from near-surface aquifers to flow down into deeper bedrock aquifers along or through the well bore. The water is contaminated in four wells with flow rates of 20-150 gal/min from the Platteville and St. Peter aquifers to the Prairie du Chien-Jordan aquifer. Drift materials on and south of the site have been contaminated by surface spills and by infiltration of contaminated process water. Near the contamination source, a hydrocarbon fluid phase is moving vertically relative to movement of the aqueous phase. Fluid pumped from an observation well in this area contained 6,000 mg/L total organic carbon. Dissolved coal-tar constituents in the drift and the uppermost bedrock unit over most of the area (the Platteville aquifer) have moved at least 4,000 ft downgradient to a drift-filled bedrock valley. At the valley, it seems that the Platteville aquifer and the Glenwood confining bed have been removed by erosion and that contaminants with a concentration of about 2 mg/L dissolved organic carbon are entering the underlying St. Peter aquifer. Chemical analyses of fluid pumped from observation wells suggest that soluble, low molecular weight compounds are moving preferentially through the drift and the Platteville aquifer. (Lantz-PTT)
W89-10953

SEWAGE PLUME IN A SAND AND GRAVEL AQUIFER, CAPE COD, MASSACHUSETTS,
D. R. LeBlanc.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 2218, 1984. 28p, 18 fig, 2 tab, 34 ref.

Descriptors: *Wastewater disposal, *Water pollution sources, *Groundwater pollution, *Aquifers, *Cape Cod, *Path of pollutants, *Massachusetts, Plumes, Boron, Chlorides, Sodium, Phosphorus, Ammonia, Solute transport.

Secondarily treated domestic sewage has been disposed of on surface sand beds at the sewage treatment facility at Otis Air Force Base, MA, since 1936. Infiltration of the sewage through the sand beds into the underlying unconfined sand and gravel aquifer has resulted in a plume of sewage contaminated groundwater that is 2,500 to 3,500 ft wide, 75 ft thick, and > 11,000 ft long. In the center of the plume, detergent concentrations as high as 2.6 mg/L as methylene blue active substances, ammonia-nitrogen concentrations as high as 20 mg/L, boron concentrations as high as 400 micrograms/L (ug/L), and specific conductance as high as 405 micromhos/cm were measured. Chloride, sodium, and boron are transported by the southward-flowing groundwater without significant retardation, and seem to be diluted only by hydrodynamic dispersion. The movement of phosphorus is greatly restricted by sorption. Phosphorus concentrations do not exceed 0.05 mg/L farther than 2,500 ft from the sand beds. The center of the plume as far as 5,000 ft from the sand beds contains nitrogen as ammonia, but no nitrate and no dissolved oxygen. Ammonia also is oxidized to nitrate along the top and sides of the plume within 5,000 ft of the beds. (Lantz-PTT)
W89-10957

ACID RAIN: THE RELATIONSHIP BETWEEN SOURCES AND RECEPTORS.
Proceedings of a Conference Sponsored by: Center for Environmental Information, Inc., Rochester, NY. Elsevier Science Publishers, New York. 1988. 223 p. Edited by James C. White and Carole N. Beal.

Descriptors: *Air pollution effects, *Water pollution sources, *Path of pollutants, *Acid rain effects, *Water pollution effects, *Acid rain, Economic aspects, Sulfuric acid, Nitric acid, Costs, Ecosystems, Legislation, Sulfur, Nitrates, Fate of pollutants.

Acidic deposition is one of the more scientifically complex and subtle environmental issues to emerge in the last decade. Although sulfuric and nitric acids formed in the atmosphere from sulfur and nitrogen oxides can affect health and damage natural resources and materials near their sources, the political debate over acidic deposition has differed from many environmental issues by centering around sources geographically far removed from sensitive receptors. If a program to control acidic deposition is implemented, the economic and social costs will be high; however, the long-term costs from the effects of acidic deposition could also be high. One crucial component of the debate is reflected in the title of the conference--'Acid Rain: The Relationship between Sources and Receptors'- whose papers are presented in this volume. Several thematic issues are examined: (1) the necessity to understand source-receptor relationships; (2) learning about source-receptor relationships (3) information about source-receptor relationships is still needed to explain the impacts of acidic deposition on aquatic and terrestrial ecosystems; (4) using source-receptor relationships to devise control strategies; (5) given the incomplete nature of current knowledge of source-receptor relationships, can the US. EPA allocate emission reductions to control acid deposition through its authority under the Clean Air Act, or is new legislation needed; and (6) questions Congress has been considering in drafting control legislation. (See W89-10966 thru W89-10974) (Lantz-PTT)
W89-10965

ACID RAIN: THE EMERGING LEGAL FRAMEWORK,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
N. Orloff, and L. A. Byrns.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 11-25.

Descriptors: *Water law, *Acid rain, *Legislation, *Water pollution control, *Air pollution control, *Legal aspects, Federal jurisdiction, State jurisdiction, Acid Precipitation Act, Model studies, Environmental effects, Standards, Air pollution effects, Research priorities, Monitoring, Economic impact, Appropriation.

Congress is still in the early stages of developing legislation to control acid rain. During 1986, five bills were introduced in Congress and hearings were held on them; but, no legislation reached the floor of either chamber. In 1980, Congress passed the Acid Precipitation Act of 1980, which created a task force to study the causes and effects of acid rain. This twenty-member group, known as the Acid Precipitation Task Force, is required to develop and carry out a 10-yr comprehensive research plan under a total appropriation of $50 million. This research plan includes a nationwide, long-term monitoring network measuring levels of acid rain and a program studying emissions sources which contribute to acid precipitation. The plan also addresses both long-range atmospheric transport models and economic assessments. These assessments concern the environmental impact of acid precipitation and the alternative technologies to remedy or ameliorate acid rain's harmful effects. The Act does not impose any limitations on emissions. Congress is still in the process of developing a foundation for the eventual passage of control legislation. At the present time, there is not consensus on the specific provisions of this legislation. In the absence of this consensus, efforts at the federal level to control acid rain have rested on existing legislation--the Clean Air Act. While not specifically designed to address the acid rain problem, the Act does contain provisions that are susceptible to being employed to control the long-range transport of pollutants. This paper briefly describes: (1) the efforts in Congress during 1986 to develop new legislation to control acid rain; (2) the provisions of the Clean Air Act that states and environmental groups have used as an interim solution pending the enactment of new legislation by Congress; and (3) efforts at the state level to address the problem. (See also W89-10965) (Lantz-PTT)
W89-10966

LEGAL ASPECTS OF THE SOURCE-RECEPTOR RELATIONSHIP: AN AGENCY PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Air and Radiation Div.
C. S. Carter.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 27-30.

Descriptors: *Path of pollutants, *Administrative agencies, *Air pollution control, *Legal aspects, *Water pollution sources, *Acid rain, *Legislation, *Water pollution control, *Clean Air Act, *Clean Water Act, Regulations, Water quality standards, Planning, Air pollution effects, Particulate matter, Reviews, Technology, Environmental policy, Environmental quality, Surveys.

How effectively or ineffectively the Clean Air Act operates to deal with the long-range transport issue is examined. The key mechanism is the regulations relating to existing sources under Sections 108, 109 and 110 of the Act, representing a three-step process. It starts with the listing of a pollutant, based on criteria set out in 108. Once the pollutant criteria are selected, the Administrator has further the duty to establish both primary and secondary ambient air quality standards for that particular pollutant. From there, once the standard is established, the next step is the implementation of the standard itself, through the Section 110 process for establishing State Implementation Plans (SIPs). In a field like acid rain, where there is a range of effects about which only scattered and incomplete information is available, the EPA is not presented with a nice, neat basis for an informed regulatory judgement. In such a case, the ongoing SO2 and particulate standard reviews that are underway must be considered, and are at different stages of progress. The sulfur dioxide standard is presently under review and a proposal package should be out within the next year or so. This review tends to emphasize the cumbersome nature of the process. Much of this is inherent in the ambient standard process, which starts from a cause and effect relationship and works back to the source. Some have suggested that life would have been a lot simpler if Congress had crafted an Air Act that was more akin to the Water Act, using a technology-based approach. The Agency is presently faced with a statute that was crafted originally in 1970, with 1977 refinements, to gauge basically localized pollution problems based on the ambient approach established in the 108, 109 and 110 process. It is just not well-suited to the kind of phenomenon being dealt with here. The situation therefore remains, where Congress must press on to obtain the knowledge needed to make informed judgements on what type of regulatory program, if any, is appropriate to address the acid rain phenomenon. (See also W89-10965) (Lantz-PTT)
W89-10967

ATMOSPHERIC CHEMISTRY-A LAY PERSON'S INTRODUCTION,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
For primary bibliographic entry see Field 2B.
W89-10969

INFORMATION NEEDS-AQUATIC,
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
G. E. Likens.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 101-119, 13 fig, 33 ref.

Descriptors: *Research priorities, *Air pollution effects, *Acid rain, *Path of pollutants, *Aquatic environment, Acidification, Literature review, Sulfates, Nitrates, Sulfur, Nitrogen, Reforestation, Ecological effects.

Much is known about the acidification of aquatic ecosystems. There have been thousands of individual papers and several major reviews published on the subject, but still there is much to learn. To understand how changes in chemistry are related to biological damage, scientists need to know how the rate of chemical change is dependent upon the input of sulfur, nitrogen, hydrogen ion, base cations and metals. These inputs vary seasonally and over the long term. Knowledge is also needed about lakes and streams themselves, what their biological and chemical characteristics are, how deep they are, what kind of watersheds they have, what kind of alkalization potential there is within the terrestrial watershed and within the lake itself. This literature review presents a brief summary of what is known about acid rain inputs and its effects on the aquatic environment, through discussions of: (1) the variability of atmospheric inputs of nitrates and sulfates; (2) afforestation; (3) acid deposition to sensitive ecosystems (examples are presented from Alaska and Norway); (4) individuality and environmental response; and (5) recovery and regulation. (See also W89-10965) (Lantz-PTT)
W89-10970

SIMULATING SOURCE-RECEPTOR RELATIONSHIPS FOR ATMOSPHERIC CONTAMINANTS,
Michigan Univ., Ann Arbor. Rocket Propulsion Lab.
P. J. Samson.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 129-142, 10 fig, 7 ref.

Descriptors: *Path of pollutants, *Air pollution, *Water pollution sources, *Acid rain, *Simulation

analysis, Fate of pollutants, Data interpretation, Meteorology, Model studies, Computer models, Chemistry of precipitation, Atmospheric transport, Sensitivity analysis, Estimating, Error analysis, Analysis of variance, Environmental tracers.

Source-receptor relationships for atmospheric contaminants are estimated frequently through the use of these computer simulation models. Unfortunately, the accuracy of models in estimating source-receptor relationships has never been tested directly because the 'true' flow of air over distances greater than a few hundred kilometers is difficult to prescribe. Instead, their skill has been inferred from their ability to reproduce temporal and/or spatial patterns of observed ambient concentrations and/or pollution deposition. This paper presents: representative estimates of source-receptor relationships from current atmospheric transport models; an analysis of the uncertainty in source-receptor relationships based on uncertainties in model parameters; an analysis of the variability in source-receptor relationships based on variability in meteorological conditions; and a description of how the next generation of atmospheric transport models will be used to estimate source-receptor relationships. In terms of the transport during relatively undisturbed weather conditions, trajectories have a 50% chance of exceeding horizontal displacement errors on the order of 250 km after traveling for only about 24 hrs. So there is uncertainty in transport. In terms of source-receptor relationships, that is a key. If you can define the transport right, the chemistry apparently becomes much less critical, at least over an annual estimate. The matrices do not appear to be very sensitive to the transformation or deposition parameters, at least when using a simple model. The sensitivity of the matrices to nonlinearity has not been evaluated, and it should be. The simulated source-receptor matrix elements can vary by as much as 70% over the 6-yr period, though generally the variation is less. Insufficient data now exists with which to test the simulated source-receptor matrices. Further, it is unlikely that this data will become usable in the near future. It is possible that these simulations may be tested eventually through the use of empirical data employing elemental tracers of opportunity. (See also W89-10965) (Lantz-PTT)
W89-10971

NON-MODELING APPROACHES TO THE DETERMINATION OF SOURCE-RECEPTOR RELATIONSHIPS,
National Oceanic and Atmospheric Administration, Silver Spring, MD. Air Resources Lab.
L. Machta.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 143-147.

Descriptors: *Path of pollutants, *Water pollution sources, *Sulfur dioxide, *Acid rain, *Air pollution, *Monitoring, Sulfates, Sulfur, Nitrates.

After a brief review of ways in which a source-receptor relationship may be obtained, two non-modeling approaches are described. The first uses the observed decreasing time trend of sulfur dioxide emissions in eastern U.S. from about 1977-1982 and its possible correlations with observed changes in precipitation sulfate concentration or deposition. In the second, hypothetical approach, the possibility of deliberately modulating emissions of sulfur dioxide to see what kind of corresponding changes in precipitation concentrations or wet deposition of sulfates accompanies the emission changes is examined. This technique could also be applied to nitrate emissions and subsequent measurements elsewhere of nitrate concentrations or deposition. (See also W89-10965) (Lantz-PTT)
W89-10972

SOURCE-RECEPTOR RELATIONSHIPS: THE CANADIAN EXPERIENCE,
Atmospheric Environment Service, Downsview (Ontario).
J. W. S. Young.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 151-163, 6 fig, 4 tab, 15 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Canada, *Acid rain, Water pollution control, Sulfur, Costs, Economic aspects, Meteorology.

In 1982, the Canadian government decided to base its control strategy for acid rain on science. Reviewed here is the scientific approach taken (optimization) in the development of its 'selective reduction' strategy, along with some examples of the application of this science to support the strategy and talk about the conclusions reached in 1982. Scientific analyses completed between 1982 and 1986 confirm the basic conclusions in reached in the early decision: (1) removing S from the system translates over time into a decrease in both wet S deposition and flux between the U.S. and Canada; (2) Identification of the largest contributors to deposition in Canada has not changed; (3) cost optimization improves decision making when such decisions are made in finite steps; and (4) meteorological variability is very important when assessing change pointing out the necessity of baseline monitoring over an extended period. (See also W89-10965) (Lantz-PTT)
W89-10973

SOURCE-RECEPTOR RELATIONSHIPS AND CONTROL STRATEGY FORMULATION,
Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 5G.
W89-10974

MICHIGAN DIOXIN STUDIES: DOW CHEMICAL WASTEWATER CHARACTERIZATION STUDY, TITTABAWASSEE RIVER SEDIMENTS AND NATIVE FISH,
Environmental Protection Agency, Westlake, OH. Environmental Services Div.
For primary bibliographic entry see Field 5D.
W89-10993

RESIDUAL EXPLOSIVES CRITERIA FOR TREATMENT OF AREA P SOIL, LOUISIANA ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 5G.
W89-10997

SELECTION CRITERIA FOR MATHEMATICAL MODELS USED IN EXPOSURE ASSESSMENTS: GROUND-WATER MODELS,
Environmental Protection Agency, Washington, DC. Office of Health and Environmental Assessment.
For primary bibliographic entry see Field 5G.
W89-10998

BACKGROUND CONCENTRATIONS OF SELECTED ELEMENTS IN UNCONSOLIDATED SURFICIAL MATERIALS AT THE U.S. DEPARTMENT OF ENERGY KANSAS CITY FACILITY,
UNC Geotech, Grand Junction, CO.
For primary bibliographic entry see Field 5A.
W89-10999

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR ETHYLBENZENE.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-251202. Price codes: A06 in paper copy, A01 in microfiche. Report NO. EPA/600/X-86/145, June 1986. 103p, 1 fig, 17 tab, 224 ref.

Descriptors: *Water pollution effects, *Ethylbenzene, *Public health, *Path of pollutants, *Environmental effects, Aquatic environment, Volatilization, Aquatic plants, Shrimp, Oysters, Bioaccumulation, Toxicity, Drinking water, Population exposure, Microcystis, Pseudomonas, Air pollution effects, Chemistry of precipitation.

Although small amounts (4-9 nanograms/L) of ethylbenzene have been detected in rainwater, physical removal mechanisms, such as precipitation through rainfall or snowfall, through disposition of adsorbed aerosol particles and removal through impaction at the earth's surface, are not likely to remove significant amounts of atmospheric ethylbenzene. A few investigators have demonstrated the possibility of aerosol transport of ethylbenzene from its source of emission to areas substantially downwind (> 100 miles). The most significant loss process for aquatic ethylbenzene is volatilization. The half-life for volatilization is estimated to range between < 1 day and a few days. In summer months, however, when the temperature of water is higher than in other seasons, microbial degradation may be significant and may be competitive with the volatilization process. Significant removal of ethylbenzene through sorption onto particulate matters is not likely. Ethylbenzene will not significantly bioconcentrate in aquatic organisms. Ethylbenzene has been detected in natural surface water, industrial effluents, treated municipal effluents, leachates from contaminated sites and well waters--it has been detected in 7.5% of 1368 effluent samples at a median concentration of < 3.0 micrograms/L (microg/L). Surface and groundwater samples showed ethylbenzene with a frequency of 10% and a median concentration of < 5 microg/L. The concentration of ethylbenzene in U.S. drinking water can vary from 0-40 microg/L. On the basis of an average consumption of 2 L of drinking water/day, the daily exposure to ethylbenzene from drinking water can vary from 0-80 microg; however, the vast majority of the U.S. population would be exposed to the lowest dosage of ethylbenzene from ingestion of drinking water. Limited information concerning toxicity of ethylbenzene to aquatic organisms is available. Acutely toxic concentrations range from 0.42 mg/L for the bay shrimp to 1030 mg/L for the Pacific oyster. The most sensitive plant species tested was the bluegreen alga, Microcystis aeruginonsa, with a toxicity threshold of 33 mg/L, while the bacterium, Pseudemonas putida, had a toxicity threshold of 12 mg/L. (Lantz-PTT)
W89-11000

TRANSPORT OF A CONSERVATIVE SOLUTE THROUGH A SHALLOW POND BOTTOM,
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
R. H. Long, S. Benson, M. Alavi, and T. N. Narasimhan.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-01083. Price codes: A03 in paper copy, A01 in microfiche. Report No. LBL--25217, April 1988. 19p, 9 fig, 1 tab, 29 ref. DOE Contract DE-AC03-76SF00098.

Descriptors: *Chlorides, *Solute transport, *Shallow water, *Selenium, *Path of pollutants, California, Irrigation, Chemical analysis, Mathematical models, Model studies, Kesterson Reservoir.

A field experiment has been performed in an evaporation pond at Kesterson Reservoir, Merced County, California, aimed at determining average solute fluxes through pond sediments and at estimating the magnitude and degree of spatial variability of water and solute transport properties. Kesterson Reservoir, a series of shallow ponds located at the terminus of the San Luis Drain, became the object of intense public interest and scientific investigation after it was discovered in 1983 that the disposal of irrigation drain waters bearing hazardous levels of a naturally occurring element, selenium, was having serious environmental effects on plant and animal life. The primary focus of the experiment was to gain insight into the mechanism of selenium migration and immobilization. As a first step in analyzing the selenium migration data, permeability and apparent dispersion coefficient values were obtained through the history-matching of breakthrough curves of a conservative solute, chloride, at 40 sampling locations within 5 sites throughout a 40-hectare (ha) cell following pond flooding. Chloride occurring naturally throughout the soil profile was utilized in a modeling effort as a conservative tracer under conditions of transient flow, and a deterministic

one-dimensional fluid flow and transport mathematical model employing the integrated finite difference method (IFDM) was employed in the effort. Reasonable matches were obtained between the observed and calculated concentrations with the advective-dispersive code. Extreme lateral variability of soil hydraulic properties was demonstrated between and within field plots, with values of permeability and apparent dispersion coefficient varying by one to two orders of magnitude. The flow and transport properties determined throughout the field were found to conform to a log-normal distribution. The apparent dispersion coefficient is shown to be velocity dependent and exhibits a linear relationship with average pore water velocity. Estimates of dispersivity at the 40 locations appear high in relation to values measured typically in the laboratory. A general trend is observed of greater dispersivity values with increasing travel distance. (Author's abstract)
W89-11007

FIELD-STUDY DESIGN FOR MODULE EVALUATION; PRECP VI/3CP0,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
J. M. Hales.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008183. Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--15689, February 1988. 7p, 2 fig, 1 tab, 1 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Precipitation scavenging, *Air pollution, *Experimental design, *Water pollution sources, *Model studies, *Acid rain, Data acquisition, Convective precipitation, Path of pollutants, Field tests, Performance evaluation.

PRECP VI is the sixth in a progressive series of scavenging field studies, and is centered on the analysis of scavenging by summertime convective storms in polluted environments. The Regional Acid Deposition Model (RADM) contains a convective-storm scavenging module that has been developed as a component of the NAPAP program. Although this module has been designed to simulate actual scavenging phenomena as accurately as is possible within the constraints imposed by RADM's architecture, to date there has been no satisfactory evaluation of this module's performance in light of a comprehensive data set. Project objectives are: (1) to create a comprehensive data base on precipitation scavenging by convective storms for detailed evaluation of the RADM Scavenging Module; and (2) to advance the scientific understanding of scavenging by convective storms, with special emphasis on: vertical venting of boundary layer pollutants by convective updrafts; inflow-outflow processes and associated pollutant extraction efficiencies; the influence of vertical distributions of pollutants and oxidants adjacent to storms on the gross chemical-conversion and scavenging features of the systems; and the aqueous-phase chemical conversion processes important in the convective precipitation scavenging process. No results are yet available. (Lantz-PTT)
W89-11008

STATISTICAL TECHNIQUES FOR REGIONAL MODEL EVALUATION,
Battelle Pacific Northwest Labs., Richland, WA.
M. T. Dana.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008206. Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--15645, January 1988. 8p, 3 fig, 2 tab, 5 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Chemistry of precipitation, *Regional analysis, *Statistical models, *Fate of pollutants, *Acid rain, Model studies, Distribution patterns, Rainfall distribution, Statistical analysis, Performance evaluation, Simulation analysis, Seasonal variation, Model testing.

Regional acidic deposition models, such as RADM, can generate both short-term and long-term average concentrations and deposition fields for the chemistry of precipitation. Evaluation of these averages at sampling points has difficulties: low spatial grid resolution makes the test for short-term (e.g., precipitation event) averages too severe, while the predicted long-term (e.g., annual) averages can too easily approximate measurements without properly addressing mechanisms. These models, however, should be able to simulate concentration distributions at sampling points and reflect seasonal and spatial variations caused by physical and chemical processes included in the models. Project objectives of this study are: (1) to calculate and characterize precipitation concentration distributions for sampling sites in the MAP3S network (eastern U.S.) region; and (2) to evaluate the distributions in terms of spatial, seasonal, and chemical species variations, with the aim of simplifying the model evaluation process. The distributions of major ionic concentrations in precipitation in the MAP3S network region of the eastern U.S. share certain characteristics, allowing some generalization for the purpose of examining the effectiveness of acidic deposition model calculations. Three reasonably distinct spatial types may be identified: inland northeast, coastal, and midwest. Well-documented seasonal variations in species concentrations are reflected in the distributions. The techniques used here are applicable to data from other high-time-resolution sampling networks such as UAPSP and CAPMON and the model-validations networks. (Lantz-PTT)
W89-11009

RECONNAISSANCE SURVEY OF EIGHT BAYS IN PUGET SOUND,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W89-11010

SOLUBILITY OF DISPERSE DYES IN WATER: MEASUREMENT AND IMPLICATIONS,
Environmental Research Lab., Athens, GA.
G. L. Baughman, and T. A. Perenich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-250220. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/186, August 1988. 12p, 2 fig, 4 tab, 28 ref. EPA Contract CR812636.

Descriptors: *Solubility, *Fate of pollutants, *Dyes, *Path of pollutants, Chemical analysis, Water temperature, Thermodynamics, Membrane processes, Filtration, Chemical potential, Dye dispersion, Bioaccumulation, Generator columns, Entropy, Precision, Equilibrium.

The solubilities of dispersive dyes have long been of interest to dye chemists. Information about their thermodynamics of solution has contributed greatly to knowledge of the mechanism of dyeing synthetic fibers. This same mechanism is believed to be responsible for sediment accumulation and bioconcentration of many water pollutants. Insufficient data exist to permit reliable generalizations about the water solubilities of newer disperse dyes or their heats and entropies of solution. Most of the disperse dyes in common use today probably have solubilities well below 0.1 mg/L at room temperature. Conventional approaches that depend on filtration for measuring solubility will usually be inaccurate for highly insoluble compounds such as disperse dyes. The generator column is a convenient technique for determining solubility at room temperature or lower with good precision. It is especially well suited for determining solubilities of very insoluble dyes. The membrane diffusion method is best applied at elevated temperatures and is especially useful for examining the chemical potential of dyes in a complex mixture like the usual dye bath. Available data are consistent with disperse dyes existing in aqueous solution at a dimer/monomer ratio of about 1 or less, at room temperature. The ratio at elevated temperatures can not be reliably anticipated from available data but may well be higher. The generator column technique provides the required sensitivity and precision to study dye equilibria that were heretofore unattainable in aqueous systems. (Lantz-PTT)
W89-11011

WASTEWATER CHARACTERIZATION AND HAZARDOUS WASTE SURVEY, REESE AFB TX,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
R. D. Binovi, and F. E. Slavich.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 540. Price codes: A06 in paper copy, A01 in microfiche. Final Report No. 88-067EQ0165DSC, April 1988. 11p, 4 fig, 4 tab, 6 ref, 6 attachments.

Descriptors: *Wastewater composition, *Texas, *Wastewater treatment, *Hazardous wastes, Waste management, Water pollution sources, Military reservations, Sampling, Water pollution prevention.

The scope of this survey included the characterization of the wastewater existing the main oil-water separator, entering and exiting the sewage treatment and storm sewer lake, in the industrial lake, and from 19 points in the sanitary and storm sewer system of Reese Air Force Hospital, Texas. Hazardous waste management surveys were conducted at 28 locations generating or accumulating potentially hazardous waste. Priority pollutants were found in the sanitary and storm system, in the surface impoundments and in a septic system. Apparently all industrial discharges containing hazardous constituents have not been eliminated from the sanitary and stormwater systems. Priority pollutants found in the influent of the sewage treatment plant and in the sewage lake were not significant in nature or concentration. Pretreatment and removal of hazardous constituents from the wastewater will be required if the hazardous material cannot be prevented from entering the wastewater stream. The hazardous waste management program was deficient in several areas, such as insufficient hazardous waste management training, lack of baseline analytical data, inadequate segregetation of wastes prior to containerization, inadequate hazardous waste accumulation sites, and lack of documentation at the shop level concerning amounts and types of wastes generated. Recommendations included: (1) eliminating all hazardous constituents from entering the sanitary or storm water system; (2) routing shop drains to the sanitary sewer and upgrading the sewage treatment system; (3) installing positive controls in shop drains near operations involving hazardous waste to prevent any from entering the sewer; (4) implementing a waste management training program; (5) upgrading hazardous waste accumulation sites; and (6) increasing the amount of hazardous waste testing. (Author's abstract)
W89-11012

SOURCES, OCCURRENCE AND EFFECTS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE AQUATIC ENVIRONMENT-A PRELIMINARY REVIEW,
Norsk Inst. for Vannforskning, Oslo.
J. Knutzen.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-752845. Price codes: A03 in paper copy, A01 in microfiche. Report No. NIVA-E--87700/I, April 21, 1987. 21p, 1 tab, 35 ref.

Descriptors: *Water pollution effects, *Hydrocarbons, *Fate of pollutants, *Water pollution sources, *Aquatic environment, Toxicity, Bioaccumulation, Mollusks, Crustaceans, Fish, Oil pollution, Snails, Mussels, Carcinogens, Oil spills, Industrial wastes.

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous in the environment, mainly due to their formation in practically all incomplete combustions of organic material. The most problematic anthropogenic sources in the aquatic environment is connected with oil and industrial processes involving use of fossil fuels (including smelters with Soderberg electrodes or anode production). Due to low water solubility (parts per billion (ppb)-parts per million (ppm) range, depending on molecular size) most of PAH in water is associated with particulate matter, particularly in contaminated environments. In pristine areas, surface water,

groundwater and seawater will contain < 0.05-0.1 micrograms/L (ug/L) total PAH. Total PAH content of organisms will vary somewhat with the species, even in uncontaminated environment, typical values for mussels (< 0.5-1.0 mg/kg dry weight) and fish (< 0.02(0.05) mg/kg dry weight). Potentially carcinogenic PAHs usually constitute < 5-20% of total, benzo(a)pyrene < 1-5%. PAHs are metabolized by certain bacteria and fungi, most groups of invertebrate animals and by fish. Mollusks (snails and in particular mussels) show low activity of the necessary enzymes. Fish rarely show more than moderate excess concentrations even in contaminated environment, whereas PAH in mussels and snails may reach 3 orders of magnitude higher concentrations than the 'normal' levels; crustacea having an intermediate position. Half-lives of PAH under experimental conditions have been observed to be of the order 1-4 weeks in fish and mussels (fastest release from fish). Organisms with no or little metabolic activity (mussels), which at the same time have a long history of contamination, may show slower purification. Acute toxicity is moderate in the sense that lethal concentration will be rare in nature, even in recipients with a high PAH loading (oil spills represent an exception). Although many individual PAHs have shown effects on growth and cell division in the 1-100 ppb range, consequences on the community level has been difficult to demonstrate. (See also W89-11013) (Lantz-PTT)
W89-11014

INTERACTIONS BETWEEN THORIUM AND HUMIC COMPOUNDS IN SURFACE WATERS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
N. Miekeley, and I. L. Kuchler.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-702291. Price codes: A03 in paper copy, A01 in microfiche. 12p, 4 fig, 1 tab, 16 ref. International Atomic Energy Agency Research Contract 3937-BR.

Descriptors: *Radioactive tracers, *Fate of pollutants, *Path of pollutants, *Thorium, *Humic acids, *Surface water, Chemical reactions, Organic carbon, Geochemistry, Clays, Suspended sediments, Sorption, Radioactive waste disposal.

As a result of their close chemical similarities to Pu(IV) and trivalent transuranics (Am, Cm), thorium and rare earth elements can be useful chemical analogs for the study of interactions of critical radioactive nuclides with the near--and far-field of nuclear waste repositories. Utilizing a thorium-rare earth deposit in the State of Minas Gerais, Brazil, a site with unusually high levels of natural radioactivity (1-3 millirems (mR)/hr), a systematic investigation was carried out to get fundamental information about the environmental behavior of these transuranium analogs. The highest concentrations of Th-232 (17 micrograms/L were found in organic-rich percolation waters, in which Th-232 is predominantly associated with colloidal humic acids (as shown by ultrafiltration experiments). Correlation between the concentration of humic carbon (DOC > 1,000 mwu) in water and that of Th-232 was observed. The presence of these natural complexants also affects the distribution of thorium between water and suspended clay material, as demonstrated by radioactive tracer experiments. (Lantz-PTT)
W89-11015

TWO-DIMENSIONAL FINITE ELEMENT MODEL FOR SOLUTE TRANSPORT IN MULTI-AQUIFER SYSTEMS,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 2F.
W89-11022

RECONNAISSANCE INVESTIGATION OF WATER QUALITY, BOTTOM SEDIMENT, AND BIOTA ASSOCIATED WITH IRRIGATION DRAINAGE IN THE LOWER COLORADO RIVER VALLEY, ARIZONA, CALIFORNIA, AND NEVADA, 1986-87,
Geological Survey, Tucson, AZ. Water Resources Div.
D. B. Radtke, W. G. Kepner, and R. J. Effertz.
U.S. Geological Survey Water-Resources Investigation Report 88-4002. Tucson, AZ. February 1988. 77p, 7 fig, 18 tab, 97 ref.

Descriptors: *Water pollution sources, *Pesticides, *Surveys, *Water quality, *Bottom sediments, *Irrigation effects, *Colorado River, *Arizona, *California, *Nevada, Selenium, DDE, Water sampling, Water analysis, Population exposure, Fish, Wildlife, Agricultural runoff, Water quality standards.

The Lower Colorado River Valley Irrigation Drainage Project area included the Colorado River and its environs from Davis Dam to just above Imperial Dam. Water, bottom sediment, and biota were sampled at selected locations within the study area and analyzed for selected inorganic and synthetic organic constituents that are likely to be present at toxic concentrations. With the exceptions of selenium and DDE, this study found sampling locations to be relatively free of large concentrations of toxic constituents that could be a threat to humans, fish, and wildlife. Selenium was the only inorganic constituent to exceed any existing standard, criterion, or guideline for protection of fish and wildlife resources. Concentrations of DDE in double-crested cormorants, however, exceeded the criterion of 1.0 microgram per gram established by the National Academy of Sciences and the National Academy of Engineering for DDT and its metabolites for protection of wildlife. Dissolved-selenium concentrations in water from the lower Colorado River appear to be derived from sources above Davis Dam. At this time, therefore, agricultural practices in the lower Colorado River valley do not appear to exacerbate selenium concentrations. This fact, however, does not mean that the aquatic organisms and their predators are not in jeopardy. Continued selenium loading to the lower Colorado environment could severely affect important components of the ecosystem. (Author's abstract)
W89-11067

5C. Effects Of Pollution

COMBINED NEPHROTOXICITY OF METHYLMERCURY, LEAD AND CADMIUM IN PEKIN DUCKS: METALLOTHIONEIN, METAL INTERACTIONS, AND HISTOPATHOLOGY,
Ontario Veterinary Coll., Guelph.
For primary bibliographic entry see Field 5B.
W89-10533

BARNACLES AND MUSSELS AS BIOMONITORS OF TRACE ELEMENTS: A COMPARATIVE STUDY,
Hong Kong Environmental Protection Dept.
For primary bibliographic entry see Field 5A.
W89-10538

INFLUENCE OF RUNOFF ON INTERTIDAL MUDFLAT BENTHIC COMMUNITIES,
Department of Scientific and Industrial Research, Hamilton (New Zealand). Water Quality Centre.
D. S. Roper, S. F. Thrush, and D. G. Smith.
Marine Environmental Research MERSDW, Vol. 26, No. 1, p 1-18, 1988.

Descriptors: *Water pollution sources, *Water pollution effects, *Runoff, *Benthos, *Mud flats, *Sediments, Heavy metals, Sediment erosion, Catchment areas, Oligochaetes, Polychaetes, Amphipods, Crabs, Snails, Pollutants, Cadmium, Copper, Lead, Zinc, Hydrocarbons.

Intertidal mudflats receiving runoff from different sub-catchments were sampled to assess the effects of runoff on surficial sediments and benthic communities in Manukua Harbour (New Zealand). High sediment concentrations of hydrocarbons, cadmium, copper, lead, and zinc indicated that runoff was causing significant sediment contamination. The mudflat fauna was dominated by a combination of small, opportunistic species, such as tubificid oligochaetes, the polychaetes Heteromastus filiformic and the amphipod Proharpinia hurleyi, and large, long-lived, hardy species, such as the crabs Helice crassa and Macrophthalmus hirtipes and the pulmonate gastropod Amphibola crenata. Within site variability in species numbers was low, probably mainly as a result of a high level of species mobility, although large scale disturbances may have also been implicated. Comparisons between stations revealed low numbers of species and individuals at only the most heavily contaminated site. However, patterns of community structure revealed by multivariate analysis were correlated with gradients of various sedimentary variables, including several contaminants. It also seems likely that other factors were influencing between-station differences in community structure, including stochastic variation in recruitment and various species interactions. The latter is supported by the fact that significant correlations (both negative and positive) existed between densities of several species. The study highlights the difficulty of detecting runoff effects at the benthic community level. This is true despite the fact that the Manukau Harbor has a large city within its catchment and, compared with other urbanized estuaries, has only relatively small point sources of pollution. (Author's abstract)
W89-10545

REPRODUCTIVE CONDITION OF DUNGENESS CRABS, CANCER MAGISTER, AT OR NEAR LOG TRANSFER FACILITIES IN SOUTHEASTERN ALASKA,
National Marine Fisheries Service, Auke Bay, AK. Auke Bay Lab.
C. E. O'Clair, and J. L. Freese.
Marine Environmental Research MERSDW, Vol. 26, No. 1, p 57-81, 1988. 4 fig, 10 tab, 43 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Crabs, *Alaska, *Logging, *Wood wastes, Fecundity, Bays, Hydrogen sulfide, Ammonia, Reproduction.

To determine if the reproductive condition of female Cancer magister is altered by exposure to decomposing bark and wood waste at log transfer facilities (LTFs), five reproductive variables in crabs resident at or near LTFs in six bays in southeastern Alaska were compared with those in crabs at nearby control sites. Crabs were collected at all sites in spring 1982 and at one bay (Rowan Bay) in November 1982 and April 1983. Crabs were in contact with bark deposits only at Rowan Bay LTF which, throughout the study, harbored a smaller percentage of ovigerous crabs with lower fecundity than did the control site. The percentage of ovigerous crabs and crab fecundity at the other bays averaged 81% and 890,000 eggs, respectively. Concentrations of hydrogen sulfide and ammonia were elevated in the pore water of bark deposits, but only the former reached concentrations acutely toxic to some Crustacea. The level of fouling and mortality in Cancer magister eggs was directly correlated with the abundance of the nemertean egg predator Carcinonemertes errans in the crab's brood. Crabs at the LTF suffered greater egg mortality and harbored more C. errans than did the control crabs in April 1983 but not May 1982. The level of egg fouling in crabs at the Rowan Bay LTF was similar to that at the control site. (Author's abstract)
W89-10546

BIOASSAY METHODS FOR EVALUATING THE TOXICITY OF HEAVY METALS, BIOCIDES AND SEWAGE EFFLUENT USING MICROSCOPIC STAGES OF GIANT KELP MACROCYSTIS PYRIFERA (AGARDH): A PRELIMINARY REPORT,
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5A.
W89-10548

ACUTE TOXICITY OF INTERSTITIAL AND PARTICLE-BOUND CADMIUM TO A MARINE INFAUNAL AMPHIPOD,
Georgia Univ., Sapelo Island. Marine Inst.

P. F. Kemp, and R. C. Swartz.
Marine Environmental Research MERSDW, Vol. 26, No. 2, p 135-153, 1988. 4 fig, 4 tab, 18 ref. EPA cooperative agreement CR812792-01.

Descriptors: Water pollution effects, *Path of pollutants, *Toxicity, *Bioassay, *Cadmium, *Amphipods, *Interstitial water, Particulate matter, Dissolved solids, Flow-through systems, Sediments.

The relative acute toxicity of particle-bound and dissolved interstitial cadmium was investigated using a new bioassay procedure. Interstitial concentration of Cd was controlled by means of peristaltic pumps, allowing separate manipulation of interstitial and particle properties. Addition of small quantities of organic-rich fine particles to sandy sediment resulted in greatly differing particle-bound Cd concentrations in sediment with similar interstitial Cd concentrations. Analysis of variance indicated no significant difference in the survival or ability to rebury in sediment of the phoxocephalid amphipod Rhepoxynius abronius, when exposed to sediment with different total Cd concentrations but nearly equal interstitial Cd concentrations; in one case, LC50 data indicated slightly increased mortality in sediment with higher total Cd concentration. At least 70.2-87.9% of mortality could be predicted from past data on mortality based on dissolved Cd concentrations. The acute toxicity of Cd to this infaunal amphipod appears to be due principally to Cd dissolved in interstitial water. The results indicate that static and flow-through bioassay tests of this organism produce comparable results with regard to mortality and survival, while the flow-through system provides a greater capacity to manipulate experimental conditions. (Author's abstract)
W89-10549

ULTRASTRUCTURE OF KIDNEYS OF DUCKS EXPOSED TO METHYLMERCURY, LEAD AND CADMIUM IN COMBINATION,
Ibadan Univ. (Nigeria). Coll. of Medicine.
P. V. V. Prasada Rao, S. A. Jordan, and M. K. Bhatnagar.
Journal of Environmental Pathology, Toxicology, and Oncology, Vol. 9, No. 1, p 19-44, 1989. 21 fig, 1 tab, 50 ref.

Descriptors: *Water pollution effects, *Synergistic effects, *Animal pathology, *Ducks, *Methylmercury, *Cadmium, *Lead, *Kidneys, *Toxicity, *Heavy metals, Environmental effects, Tissue analysis, Poisons.

Ultrastructural alterations in the kidneys of Pekin ducks exposed to various combinations of methylmercury chloride (MeHgCl), lead acetate (PbAc) and cadmium chloride (CdCl2) for 12 weeks were studied. Eight groups (Gr), each consisting of 6 female ducks, were fed diets containing no heavy metals (control), 8 mg MeHgCl/kg feed (Gr 2), 80 mg PbAc/kg feed (Gr 3), 80 mg CdCl2/kg feed (Gr 4), 8 mg of MeHgCl + 80 mg PbAc/kg feed (Gr 5), 8 mg of MeHgCl + 80 mg CdCl2/kg feed (Gr 6), 80 mg of PbAc + 80 mg CdCl2/kg feed (Gr 7), and 8 mg of MeHgCl + 80 mg PbAc + 80 mg CdCl2/kg feed (Gr 8). Renal corpuscles of ducks treated with methylmercury, Pb, Cd, either alone or in two way combinations exhibited minor ultrastructural changes. Administration of the three metals in combination caused marked changes in podocytes with fusion of secondary processes and no pedicel differentiation. The proximal tubule cells (PT) accumulated lipid droplets, lysosomal bodies and membrane bound vacuoles in methylmercury treated ducks. Lead exposed ducks had a large number of secondary lysosomes and swollen mitochondria in PT cells. Cd administration caused degenerative changes in PT cells which included accumulation of lysosomal bodies containing degenerating organelles, lipid droplets and vacuoles containing myelin figures. Marked degenerative changes in PT cells and interstitial fibrosis was prominent when cadmium was concomitantly administered with the other metals. Concurrent administration of all three metals caused enhancement of degenerative changes in proximal tubule cells and collecting duct cells. These observations suggest that the combined administration of metals causes renal damage that appear to be additive. (Author's abstract)
W89-10586

STUDY OF NITRATE AND NITRITE IN THALE SAP SONGKLA: WATER QUALITY OF THALE SAP SONGKLA I,
Prince of Songkla Univ. (Thailand). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-10591

LONG-TERM CHANGES IN THE LAKE MYVATN ECOSYSTEM,
Iceland Univ., Reykjavik. Biological Inst.
For primary bibliographic entry see Field 2H.
W89-10609

FADING RECOVERY: A CONCEPTUAL MODEL FOR LAKE VESIJARVI MANAGEMENT AND RESEARCH,
Lahti Municipal Lab. (Finland).
J. Keto, and I. Sammalkorpi.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 193-204, 1988. 6 fig, 3 tab, 62 ref.

Descriptors: *Lake management, *Eutrophication, *Limnology, *Lake restoration, Cyanophyta, Fish management, Phosphorus, Lake Vesijarvi, Finland, Model studies, Phytoplankton, Predation.

Lake Vesijarvi has a long history of eutrophication and partial recovery. For 60 years, poorly treated sewage from the City of Lahti was discharged into the Enonselka basin. The annual loading rose to 2 g P/sq m in the 1960s. Enonselka became the largest highly eutrophic basin in Finland. In 1976 the sewage load was completely diverted from Lake Vesijarvi. Improvement of the water quality was very rapid during the first two years, but in spite of improved oxygen conditions and reduced nutrient levels, summer blooms of blue-green algae persisted in the 1980s. A conceptual model was constructed to synthesize the available information on the various inter-connected factors having direct or indirect effects on the persistence of phytoplankton blooms even in the absence of external loading: fishing and fish stock management, food web, sediments and their interactions. The underlying idea of the model is that the doubling of P concentrations via internal loading and the consequent blooms of cyanobacteria in the Enonselka basin are maintained by the present fish population both directly (by benthivory of roach and bream) and indirectly (by planktivory of roach, bream, bleak and smelt). Very low and selective fishing pressure, directed at the few economically valuable species and the modest stocks of predatory fish, are important because they contribute to the high biomass of coarse fish. An ecological management plan is presented which includes direct measures and a diverse monitoring program of water quality, plankton, macrophytes, fish catches and fish populations to estimate the effects of the implemented measures. (Sand-PTT)
W89-10614

LONG-TERM CHANGES IN LITTORAL HABITATS AND COMMUNITIES IN LAKE MIKOLAJSKIE (POLAND),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W89-10615

TOLERANCE AND STRESS IN A POLLUTED ENVIRONMENT: THE CASE OF THE MUMMICHOG,
Rutgers - The State Univ., Newark, NJ. Dept. of Biological Sciences.
J. S. Weis, and P. Weis.
BioScience BISNAS, Vol. 39, No. 2, p 89-96, February 1989. 4 fig, 54 ref.

Descriptors: *Fish, *Water pollution effects, *Toxicity, *Methylmercury, *Heavy metals, *Mercury, *Killifish, Tolerance, Stress, Embryonic growth stage, Physiological ecology, Adaptation, Fish eggs, Life history studies.

Populations of organisms that have been chronically exposed to chemical pollutants may develop increased tolerance, or resistance, to those toxicants. Tolerance may result from genetic adaptation or physiological adaptation to the polluted environment. Studies with the mummichog, or killifish (Fundulus heteroclitus) have shown that tolerance can be restricted to certain life history stages and to specific toxins, and can coexist with signs of stress. Development of tolerance to methylmercury exposed fish results in decreased salinity tolerance and tolerance to inorganic mercury (HgCl2) of eggs and embryos and slower growth and weakness as adults. The slower regeneration ability and increased mortality in methylmercury exposed adults probably reflect the stress of living in a contaminated environment. The fish start out as tolerant embryos, but their larval tolerance is comparable to that of the reference population; when they reach the adult stage they appear to be worn down and stressed. These symptoms include early reproduction, diminished growth and regeneration rate, reduced longevity and less feeding. Possible physiological mechanisms of methylmercury tolerance in Fundulus are discussed. Studies were conducted to investigate physiological versus genetic causes for the methylmercury tolerance; however, no evidence for physical acclimation could be found. (Sand-PTT)
W89-10627

EFFECTS OF TREATED SEWAGE ON THE AVAILABILITY OF CADMIUM TO COHO SALMON,
Seattle Metro Water Quality Lab., WA.
J. A. Buckley, and G. A. Yoshida.
Chemical Speciation and Bioavailability, Vol. 1, No. 1, p 25-30, April 1989. 1 fig, 2 tab, 39 ref.

Descriptors: *Water pollution effects, *Bioavailability, *Path of pollutants, *Cadmium, *Salmon, *Biological magnification, *Fish, *Wastewater pollution, Chemical reactions, Ligands, Effluents, Liver, Gills, Kidneys, Alkalinity, Organic carbon.

Juvenile coho salmon exposed for 30 days to dilutions of sewage treatment effluent (STPE) with approximately 2 microgram Cd/L showed increased Cd in liver, gill, and kidney tissues. In the liver the increase was unrelated to concentration of STPE, whereas in the gills some treatment effects were apparent in the lower dilutions. In the kidneys Cd concentration varied inversely with the percentage of STPE and levels of total alkalinity as well as total organic carbon in test solutions. The complexation of Cd by either organic or inorganic ligands, or a combination of the two reduced the amount available to juvenile coho salmon. It appears that the ligands in STPE complex Cd and cause a reduction in the amount available to bioconcentrate. Neither the average concentration of total Cd nor that of Chelex-labile Cd in the test solutions was indicative of Cd bioavailability. (Author's abstract)
W89-10637

DIFFERENTIAL SUSCEPTIBILITY OF A FISH, TILAPIA OREOCHROMIS MOSSAMBICUS (TELEOSTEI, CICHLIDAE) TO HEPATOCARCINOGENESIS BY DIETHYLNITROSAMINE AND METHYLAZOXYMETHANOL ACETATE,
National Univ. of Singapore. Dept. of Zoology.
J. L. Ding, P. L. Hee, and T. J. Lam.
Carcinogenesis CRNGDP, Vol. 10, No. 3, p 493-499, March 1989. 4 fig, 1 tab, 27 ref. Research and Development Assistance Scheme Grant No. BM/85/06.

Descriptors: *Water pollution effects, *Fish, *Tilapia, *Fish physiology, *Liver, *Carcinogens, *Diethylnitrosamine, *Methylazoxymethanol acetate, Toxicity, Tumors, Fry, Spawning, Tissue analysis, Bioassay.

Oreochromis mossambicus, commonly known as tilapia, is a freshwater teleost with a wide tolerance to environmental conditions. Multiple focal lesions in the liver were observed 2 months after cessation of a one-month long treatment with 100 ppm diethylnitrosamine. Cells were small and compact and arranged in sheets. Ultrastructurally, these cells have abundant endoplasmic reticulum, round mito-

chondria, less conspicuous golgi apparatus and fat droplets. Other organs like the intestines, spleen, kidneys, ovaries and pituitary appeared normal. Two liver inducible enzymes gamma-glutamyl transferase and tyrosine aminotransferase were elevated by 5-and 3-fold respectively. Aggressive migration of hepatocytes was observed in tumorigenic liver explants. Vitellogenesis and early embryological development appeared unaffected as the female fish spawned during hepatocarcinogenesis. However, their fry were stunted and short-lived. To compare the susceptibility of tilapia to another hepatocarcinagen, the fish were also treated with methylazoxymethanol acetate at 10 ppm for 0.5-1 hr. However, methylazoxymethanol acetate was too toxic and 75% of the fish succumbed 1 day after treatment. Moreover, after 2 months post-treatment, neither tumors nor change in enzyme activities were observed in any organ. These results suggest that tilapia could be a useful model for screening and differentiating carcinogens since they could develop liver tumors within only 2 months after treatment with diethylnitrosamine. (Author's abstract)
W89-10647

BRACKISH-WATER INVADERS IN THE RIVER RHINE: A BIOINDICATION FOR INCREASED SALINITY LEVEL OVER THE YEARS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
C. den Hartog, F. W. B. van den Brink, and G. van der Velde.
Naturwissenschaften NATWAY, Vol. 76, No. 2, p 80-81, February 1989. 1 tab, 8 ref.

Descriptors: *Bioindicators, *River systems, *Brackish water, *Species composition, *Water pollution sources, Pollution load, Salinity, River regulations, Ecosystems, Adaptation, Nutrients, Foreign waters, Eutrophication, Stagnant water, Ships, The Netherlands.

The influence of pollution and the shipping traffic on the structure and functioning of the ecosystem of the River Rhine has been disastrous. Typical riverine habitats have been destroyed by regulation and normalization efforts. The increasing load of nutrients and system-foreign contaminants has greatly reduced the self-purification capacity of the river. Many sensitive organisms have become extinct or rare, including almost all fish and insects characteristic of river systems. The present fauna consists mainly of the same species which occur in eutrophic stagnant freshwater. The brackish-water species are found commonly near Nijmegen, close to the border between The Netherlands and Germany. Undoubtedly the occurrence of brackish-water species in the freshwater stretch of the river is a result of the increasing salinity of the Rhine, which at present has 10 to 15 times its natural salt content. A further penetration of brackish-water species can be expected, as long as dumping of salts in the River Rhine continues at the present rate. (Fish-PTT)
W89-10658

ECOLOGICAL STATUS OF THE SEDIMENT COMMUNITIES OF CASTRIES HARBOUR, ST LUCIA, WEST INDIES,
Caribbean Environmental Health Inst., Castries (St. Lucia).
D. J. Shim, and N. C. Singh.
Ocean & Shoreline Management, Vol. 11, No. 2, p 145-158, 1988. 3 fig, 6 tab, 10 ref.

Descriptors: *Harbors, *Species diversity, *Marine sediments, *Marine animals, *West Indies, *Environmental effects, River mouth, Storm runoff, Wastes, Ocean dumping, Species composition.

Castries Harbour is St. Lucia's main seaport, containing recreational, commercial, and residential sectors. These activities naturally have some impact on the water quality and marine life of the area. The harbor receives a variety of inputs including that from the Castries River, stormwater runoff, the Castries sewer system, and waste resulting from domestic and other miscellaneous activities around or near the harbor's periphery. It is also subject to illegal dumping. A study of the macrofauna of the sediments of the harbor, using community factors and diversity indices, shows that although the outer harbor supports a healthy community, the inner section shows signs of environmental stress resulting from a variety of anthropogenic influences in that part of the harbor. In comparison with other harbors in the region, however, Castries Harbor appears to support a more healthy and diverse community, indicating a substantially lower level of environmental stress. (Fish-PTT)
W89-10662

ALUMINIUM AND ACID RAIN: MITIGATING EFFECTS OF NACL ON ALUMINIUM TOXICITY TO BROWN TROUT (SALMO TRUTTA FARIO) IN ACID WATER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Toxicology.
D. Dietrich, C. Schlatter, N. Blau, and M. Fischer.
Toxicological and Environmental Chemistry TXECBP, Vol. 19, Nos. 1 & 2, p 17-23, 1989. 2 fig, 4 tab, 16 ref. Swiss National Research Foundation Grant No. 3. 137-0.85.

Descriptors: *Acid rain, *Trout, *Mountain lakes, *Water pollution effects, *Aluminum, Sodium chloride, Fish stocking, Neutralization, Toxicity, Hydrogen ion concentration, Conductivity, Salts, Electrolytes, Survival, Switzerland, Norway.

The comparison of a fish stocking experiment in a Swiss mountain lake (Lake Laiozza) with results obtained in a South Norwegian lake (Lake Liervatn) revealed contradictory results as to the toxicity of the respective acid water. This was true even though the pH, aluminum concentration, conductivity, and ionic composition of the two lakes proved to be almost identical. Lake Liervatn water was less toxic and had a substantially higher sodium chloride (NaCl) concentration. In order to answer the question whether NaCl could have a mitigating effect on pH-aluminum toxicity to fish, experiments were performed in the laboratory using 'Synthetic Laiozza,' a media made up from deionized water and salts added according to the concentrations found in Lake Laiozza. Synthetic Laiozza was then enriched with 0, 0.125, 0.25, and 0.5 milliequivalents (meq) NaCl per liter media. The addition of 0, 0.125, 0.25, and 0.5 meq NaCl per liter had no significant effect on the survival time of the fish, whereas the addition of 4.0 meq NaCl per liter resulted in longer survival of the fish. The analyses of plasma electrolytes, on the other hand, revealed a progressive reduction in electrolyte loss with increasing ambient NaCl concentration. (Author's abstract)
W89-10667

MATHEMATICAL MODEL OF THE BROWN TIDE,
State Univ. of New York at Stony Brook. Dept. of Applied Mathematics and Statistics.
For primary bibliographic entry see Field 2L.
W89-10669

EFFECTS OF HYDROCARBONS ON THE SETTING OF THE AMERICAN OYSTER, CRASSOSTREA VIRGINICA, IN INTERTIDAL HABITATS IN SOUTHEASTERN NORTH CAROLINA,
North Carolina Univ., Wilmington. Dept. of Biology.
C. M. Smith, and C. T. Hackney.
Estuaries ESTUDO, Vol. 12, No. 1, p 42-48, March 1989. 8 tab, 21 ref.

Descriptors: *Hydrocarbons, *Oil, *Gasoline, *Water pollution effects, *Estuaries, *Oil pollution, *North Carolina, *Intertidal areas, *Oysters, Clams, Barnacles, Larvae.

Effects of petroleum covered substrate on intertidal oyster spat (Crassostrea virginica) set were measured at three intertidal elevations in a southeastern North Carolina estuary. Mercenaria mercenaria shells were coated with Bunker C crude oil or a 40:1 mixture of gasoline:2-cycle engine oil and placed intertidally for seven 13-d periods. Spat densities were significantly lower on oil treatments versus control and gas-treated shells in the high intertidal zone. This was principally attributed to an increased sediment coat on oiled shells. Maximum spat size was smaller on oil-treated shells at all elevations when compared to gas and control shells, indicating that setting may be delayed on oiled shells. For all experimental 13-d periods in the low intertidal zone and for three periods in the mid-tidal zone, barnacle densities (primarily Balanus improvisus and B. eburneus) were significantly greater on oiled shells than on control shells. (Author's abstract)
W89-10672

SIMPLE MODEL SYSTEM FOR SMALL SCALE IN VITRO STUDY OF ESTUARINE SEDIMENT ECOSYSTEMS,
Aberdeen Univ. (Scotland). Dept. of Genetics and Microbiology.
For primary bibliographic entry see Field 5B.
W89-10702

EFFECT OF SELENIUM ON REPRODUCTIVE BEHAVIOR AND FRY OF FATHEAD MINNOWS,
North Texas State Univ., Denton. Dept. of Biological Sciences.
M. Pyron, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 609-613, April 1989. 2 fig, 17 ref.

Descriptors: *Heavy metals, *Water pollution effects, *Fish, *Selenium, Animal behavior, Reproduction, Spawning, Bioassay, Sublethal effects, Mortality.

Because selenium has been shown to accumulate in gonads of fish, with subsequent reproductive effects, an attempt was made to determine if exposure to water-borne selenium would adversely impact reproductive behavior in fathead minnows. Behaviors were observed in 38-l aquaria containing split-polyvinyl chloride tubing in lengths of 8 cm for nest sites. Measured concentrations of selenium in water samples were 66 mg/l, 36 mg/l, and 20 mg/l for nominal concentrations of 60 mg/l, 30 mg/l, and 20 mg/l, respectively. Five fish exposed to 60 mg/l died during the 24-hr exposure period and the other five fish in this group died within 24 hr of exposure. Only one death occurred among the fish exposed to 30 mg/l and there was no mortality in the 20 mg/l treatment group. Exposures to selenium at concentrations of 20 and 30 mg/l for 24 hr had no noticeable effect on the reproductive behaviors monitored. In general, all observed behaviors were present in both control and exposed fish. Although the reproductive behaviors were typical, and included gamete release and fertilization, the offspring tended to have edema and low survival. These results suggest that the reproductive behavior of fathead minnow does not make a good bioassay model at least for selenium, but survival and condition of the fry are more sensitive. Although the reproductive behavior of individual fathead minnows is quite variable, the overall behavior appears to be quite insensitive to water-borne selenium. (Rochester-PTT)
W89-10739

EFFECTS OF PHENOL EXPOSURE ON THE THERMAL TOLERANCE ABILITY OF THE CENTRAL STONEROLLER MINNOW,
Miami Univ., Oxford, OH. Dept. of Zoology.
N. Chagnon, and I. Hlohowkyj.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 614-619, April 1989. 1 fig, 23 ref.

Descriptors: *Organic compounds, *Water pollution effects, *Fish, Phenols, Bioassay, Sublethal effects, Thermal tolerance, Water temperature, Critical thermal maximum.

The effects of sublethal phenol exposure on the thermal tolerance, measured as critical thermal maxima (CTMax) of the central stoneroller minnow (Campostoma anomalum) were deter-

mined. During sublethal exposure the measured concentrations of phenol varied by no more than 6% from the nominal concentrations of 6.0, 8.0, 10.0, and 12.0 mg/l. The acute sublethal exposure resulted in a significant lowering of thermal tolerance in fish at each acclimation temperature. For fish acclimated at 7.5C, the control group had a mean CTMax of 28.8 C. The control value did not differ significantly ($p>0.05$) from the mean values determined for the 6.0, 8.0, or 10.0 mg/l exposure groups. The mean CTMax value (27.1 C) for the 12 mg/l exposure group did not differ significantly from the 10 mg/l group, but was significantly reduced from the values for the control and other exposure groups. The mean CTMax value for control fish acclimated at 23 C was 35.8 C. No significant differences ($p>0.5$) were found among CTMax values for control, 6.0 (35.5 C), and 8.0 mg/l (35.3 C) test groups. Central stoneroller minnows exposed to a phenol concentration of 10 mg/l had a mean CTMax value (34.7 C) that did not differ from the CTMax of fish exposed to 8.0 mg/l, but was significantly lower than the values for the control and 6.0 mg/l groups ($p<0.05$). The mean CTMax value determined for the 12 mg/l test group (32.9 C) was significantly reduced from the values determined for the control and other exposure groups. These results indicate that acute exposure to sublethal concentrations of phenol acts to decrease thermal tolerance in stoneroller minnows. (Rochester-PTT)
W89-10740

CHEMICAL AND BIOLOGICAL IMPACT OF EFFLUENT FROM EDIBLE BAMBOO SHOOT CANNING FACTORY ON A STREAM,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
N. Ueda, S. Ishikawa, K. Kadokami, Y. Uchimura, and K. Baba.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 628-233, April 1989. 4 fig, 2 tab, 9 ref.

Descriptors: *Japan, *Water pollution effects, *Effluents, *Food-processing wastes, *Bioindicators, Diatoms, Chemical oxygen demand, Biological oxygen demand, Phosphorus, Nutrients, Aquatic fungi, Performance evaluation, Comparison studies.

The influence of effluent from a factory preparing edible bamboo shoot on chemical parameters and epilithic diatoms in the Ouma River (Japan) was examined when effluent was being discharged and when it was not. When effluent was discharged into the river, the increase in concentrations between the upstream station and the one downstream of the factory in chloride and total nitrogen was slight, and for COD, BOD, and total phosphorus the increases were slightly greater. In contrast, increases in diatom densities were obvious. When the factory stopped operating, the densities of epilithic diatoms at the two downstream stations quickly decreased to the same level as the density at station 1. At stations downstream from the factory, tolerant genera such as Gomphenema, Cymbella, Navicula, and Nitzschia, increased in percentage abundance. In addition, a large amount of Sphaerotilus was seen in addition to epilithic diatoms at these stations. From these results, it appears that the epilithic diatoms living in the river reflected the degree of pollution more sensitively than the chemical parameters in this situation where pollution is not that severe (discharge measured at less than 1/150th the discharge in the river). (Rochester-PTT)
W89-10741

SUBLETHAL EFFECTS OF PHENANTHRENE, NICOTINE, AND PINANE ON DAPHNIA PULEX,
National Fisheries Research Center-Great Lakes, Ann Arbor, MI.
J. F. Savino, and L. L. Tanabe.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 5, p 778-784, May 1989. 1 fig, 3 tab, 11 ref.

Descriptors: *Bioassay, *Water pollution effects, *Organic compounds, *Nicotine, *Pinane, *Daphnia, *Sublethal effects, Phenanthrene, Gas chromatography, Reproduction, Growth, Lowest-observable-effect concentration.

Static-renewal, chronic bioassays were conducted for 16 days to test the effect of phenanthrene, nicotine, or pinane on growth and reproduction of Daphnia pulex. Gas chromatography demonstrated that the concentrations of the contaminants in test chambers decreased rapidly, and by 48 hr was <25% of the expected concentration for all chemicals. Estimated lowest-observable-effect concentrations (LOECs) were based on nominal concentrations instead of actual concentrations and therefore represent upper limits. The actual concentrations of phenanthrene, nicotine, and pinane were much lower than the nominal concentrations, possibly due to adsorption to glassware, the volatility of these contaminants, and uptake by organisms. Fecundity and growth of daphnids decreased as the nominal concentration of phenanthrene increased from 0.06 to 0.13 mg/L. The LOEC (0.06 mg/L) was about 16% of the 48-hr EC50 reported elsewhere. At 0.13 mg/L phenanthrene, the mortality was about 60% and fecundity approached zero. Nicotine also significantly reduced growth and fecundity of daphnids at nominal concentrations from 0.02 to 0.24 mg/L. The LOEC for length was 0.07 mg/L. The LOEC for fecundity was 0.18 mg/L, 75% of the reported 48-hr EC50 for nicotine; fecundity approached zero at 0.24 mg/L and mortality was about 70% at this concentration. Increasing concentrations of pinane significantly reduced growth and fecundity. The LOEC for both growth and fecundity was nominally 0.1 mg/L. This LOEC also appeared to be at a threshold, since growth and fecundity were not affected at this concentration in one replicate. No neonates were observed at 0.50 mg/L. Hence, sublethal effects of pinane increased greatly from 0.1 to 0.5 mg/L, and mortality was complete at 0.7 mg/L. (Rochester-PTT)
W89-10743

EFFECTS OF DIELDRIN, DIMETHOATE, AND PERMETHRIN ON TETRAHYMENA PYRIFORMIS,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
S. Kumar, R. Lal, and P. Bhatnagar.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 275-280, 1989. 1 tab, 14 ref.

Descriptors: *Pesticides, *Protozoa, *Water pollution effects, *Insecticides, *Dieldrin, *Dimethoate, *Permethrin, Bioassay, Morphology, Mortality, Population dynamics, Pesticides.

The effects of dieldrin, dimethoate, and permethrin on the growth of the holotrichous ciliate Tetrahymena pyriformis were studied for 5 days in laboratory cultures at approx 27 C. Concentrations of 1, 10, 50, and 100 microgram/l of each insecticide were used. T. pyriformis proved very sensitive to dieldrin and dimethoate which produced approximately 81% and 84% inhibition of growth within two days. Dieldrin caused rounding of cells, whereas dimethoate induced cell lysis. Dimethoate also triggered a general mucocyst discharge. Permethrin induced no morphological alterations. Population growth actually was greater than the control level in permethrin-treated cultures (1 and 10 microgram/l) after 2 days, although the higher two concentrations appeared to be inhibitory. After 5 days, the inhibitory effects of all three insecticides were less pronounced. (Rochester-PTT)
W89-10752

EFFECT OF LINDANE ON NUCLEIC ACIDS, PROTEIN AND CARBOHYDRATE CONTENT IN TETRAHYMENA PYRIFORMIS,
Mosul Univ. (Iraq). Dept. of Biology.
K. A. K. Al-Chalabi, and B. H. A. Al-Khayat.
Environmental Pollution ENPOEK, Vol. 57, No. 4, p 281-287, 1989. 5 fig, 23 ref.

Descriptors: *Protozoa, *Lindane, *Water pollution effects, *Insecticides, Metabolism, Bioassay, Sublethal effects, Deoxyribonucleic acid, Ribonucleic acid, Proteins, Carbohydrates, Pesticides.

The effects of lindane at 20, 40, 60, and 80 microgram/ml on the nucleic acid, protein, and carbohydrate content of Tetrahymena pyriformis were examined in at approximately 23 C. Observations were made at 24, 48, and 72 hr. All test concentrations inhibited the synthesis of DNA, RNA, protein, and carbohydrate contents. The degree of inhibition increased with increasing toxicant concentration. Protein content was most affected. The results demonstrate that macromolecule synthesis in T. pyriformis is adversely affected by lindane in the water. (Rochester-PTT)
W89-10753

SULPHITE AND SULPHATE CONCENTRATIONS IN WEATHERING PRODUCTS OF SANDY LIMESTONE AND IN DEPOSITION SAMPLES,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-10754

MERCURY INDUCED TIME-DEPENDENT ALTERATIONS IN LIPID PROFILES AND LIPID PEROXIDATION IN DIFFERENT BODY ORGANS OF CAT-FISH HETEROPNEUSTES FOSSILIS,
Jawaharlal Nehru Medical Coll., Aligarh (India). Interdisciplinary Brain Research Centre.
Y. Bano, and M. Hasan.
Journal of Environmental Science and Health (B) JPFCD2, Vol. 24, No. 2, p 145-166, April 1989. 5 tab, 36 ref.

Descriptors: *Toxicity, *Water pollution effects, *Mercury, *Metabolism, *Sublethal effects, *Heavy metals, Bioassay, Lipids, Catfish, Phospholipids, Cholesterol, Tissue analysis, Fish physiology.

The effects of mercuric chloride (HgCl2) on lipid profiles and lipid peroxidation in different body organs of freshwater cat-fish were studied. Daily exposure to HgCl2 was 0.2 mg/l for 10, 20, and 30 days resulted in depletion of total lipids in the brain, although the content of phospholipids increased significantly at 30 days. Significant diminution in C/P ratio was discernible with 30 days of exposure following mercury toxicosis. Liver exhibited elevated levels of total lipids, phospholipids, cholesterol, and C/P ratio. Interestingly, kidney showed marked decrease in the concentration of total lipids, cholesterol, and C/P ratio at higher exposure. However, the phospholipid values increased during the longer exposure. The content of total lipids and phospholipids was high in muscle but the level of cholesterol and C/P ratio were depleted. Significant increments in lipid peroxidation in brain, liver, and muscle. In kidney, the rate of lipid peroxidation was reduced significantly. The results suggest that exposure to HgCl2 enhances the peroxidation of endogenous lipids in brain, liver, and muscle. (Author's abstract)
W89-10767

DATA TO THE TOXIC EFFECT OF K-OTHRINE ON CRUSTACEANS,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
M. Presing.
Archiv fuer Hydrobiologie AHYFA4, Vol. 114, No. 4, p 621-629, February 1989. 4 fig, 14 ref.

Descriptors: *Water pollution effects, *Toxicity, *Insecticides, *Pesticides, *Crustaceans, Copepods, Gammarus, Daphnia, Median tolerance limit, Hungary.

The insecticide K-Othrine, containing deltamethrin as an active ingredient, was tested with respect to its toxicity on four crustacean species inhabiting Lake Balaton, Hungary, and its tributaries. The copepod Eudiaptomus gracilis and the amphipod Gammarus roeseli were collected from Lake Balaton; The waterfleas Daphnia hyalina and D. magna were cultured in the laboratory. LC50 values for K-Othrine in 28, 48, and 96 hour tests were: 0.08, 0.05, and 0.024 microg/L for E. gracilis; 0.2, 0.09,

and 0.03 microg/L for G. roeseli; 0.35, 0.03, and 0.013 microg/L for D. hyalina; and 26.0, 2.5, and 1.0 microg/L for D. magna. In reproduction tests performed over three generations of D. hyalina, K-Othrine significantly decreased the number of offspring and delayed the time of first births at initial concentrations of 0.005 and 0.01 microg/L, as compared with animals kept in control filtered lake water. K-Othrine, reaching the lake in similar concentrations as Malathion (0.1-132 microg/L in 1979), may be toxic to both freshwater invertebrates and fishes. (Author's abstract)
W89-10789

DISTRIBUTION OF ZOOBENTHOS IN LITTORAL OF TWO LAKES DIFFERING IN TROPHY,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
For primary bibliographic entry see Field 2H.
W89-10791

EFFECT OF INDUSTRIAL POLLUTION ON SEAFOOD CONTENT AND DIETARY INTAKE OF TOTAL AND METHYLMERCURY,
Zagreb Univ. (Yugoslavia). Inst. for Diabetes, Endocrinology and Metabolic Diseases.
For primary bibliographic entry see Field 5B.
W89-10795

ENVIRONMENTAL STRESS IN FIVE AQUATIC ECOSYSTEMS IN THE FLOODPLAIN OF THE RIVER RHINE,
Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Bilthoven (Netherlands).
W. Admiraal, E. D. de Ruyter van Steveninck, and H. A. M. de Kruijf.
The Science of the Total Environment STENDL, Vol. 78, p 59-75, January 1989. 8 fig, 5 tab, 37 ref.

Descriptors: *Ecological effects, *Rhine River, *Aquatic populations, *Flood plain management, *Stress, *Water pollution effects, Ecosystems, Brackish water, Estuarine environment, Intertidal areas, Coastal waters, Dikes, Lakes, Suspended sediments, Flushing, Shallow water, Organic wastes, Pollutants, Eutrophication, Selective media, Species diversity, Food chains, Europe.

General theories of stress ecology were applied to aquatic communities in the floodplain of the polluted River Rhine. These communities inhabited (1) a brackish section of the Ems-Dollard estuary with large intertidal flats, (2) the coastal waters of the North Sea and the adjacent Wadden Sea, (3) a former estuary of the Rivers Rhine and Meuse: the newly endiked Lake Grevelingen, (4) the shallow Loosdrecht Lakes, and (5) the lower River Rhine. These systems are characterized by natural perturbations, such as suspension of sediments and flushing of the shallow waters. Organic pollution, eutrophication, and chemical pollution r..inforce the natural tendency to severe selection in the communities, in extreme cases leading to an abundance of small and opportunistic species participating in relatively simple food chains. Signs of ecosystem distress were detectable in all five ecosystems. The application of Odum's theory on stimulation and inhibition of ecosystems helped in identifying the positive impact of man. The role of stress in natural aquatic ecosystems in the delta, together with observations on ecological recovery under reduced man-made perturbation, suggest that there is scope for effective water management that exploits the resilience of these ecosystems. (Fish-PTT)
W89-10796

PHOTOCHEMICAL CONVERSION OF CHLORINATED PHENOLIC SUBSTANCES IN AQUATIC MEDIA AS STUDIED BY AOX AND MICROTOX TESTS,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5B.
W89-10797

HUMAN EXPOSURE TO ENVIRONMENTAL POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS: AN EXPOSURE COMMITMENT ASSESSMENT FOR 2,3,7,8-TCDD,
Lancaster Univ. (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-10798

MUTAGENICITY OF REFUSE LEACHATE FROM A MUNICIPAL INCINERATOR,
Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
A. Kamiya, Y. Ose, and Y. Sakagami.
The Science of the Total Environment STENDL, Vol. 78, p 131-145, January 1989. 8 fig, 4 tab, 29 ref.

Descriptors: *Leachates, *Municipal wastes, *Incineration, *Water pollution sources, *Water pollution effects, *Solid waste disposal, *Mutagenicity, Volatility, Aromatic compounds, Tobacco, Bioassay, Ocean dumping.

Refuse leachate is produced from solid waste stocked in the deposit area of municipal incinerator plants. The mutagenicity of refuse leachate from a municipal incinerator was studied by the highly sensitive liquid rec-assay and the solvent extraction method of the Ames assay. Volatile components were found to be negative, and nonvolatile components positive, in the Ames assay and the leachate was found to have DNA-damaging capacity in the liquid rec-assay with S-9 mix. Polynuclear aromatic hydrocarbons derived from tobacco ash and carbonyl compounds generated by the putrefaction of foods were confirmed to be main contributors to DNA-damaging capacity and mutagenicity in refuse leachate. Most refuse leachate is incinerated and the residues dumped in the ocean; this is likely to cause harmful local pollution and this dumping should be stopped. (Fish-PTT)
W89-10799

METHODS FOR DETERMINING TOXICITY OF POLLUTANTS DISCHARGED INTO WATERS (METODY OKRESLANIA TOKSYCZNOSCI ZANIECZYSZCZEN WPROWADZANYCH DO WOD),
Institute of Meteorology and Water Management, Warsaw (Poland).
B. Slomczynska.
Wiadomosci Ekologiczne WEKLAF, Vol. 34, No. 3, p 307-323, 1988. 59 ref. English summary.

Descriptors: *Toxicity, *Water pollution effects, *Testing procedures, Mortality, Population exposure, Tissue analysis, Biological properties, Standards.

Methods used to determine the toxicity of different pollutants discharged into waters were reviewed. Basic methodological guidelines are given, concerning the design of tests, required equipment, time of exposure to a toxicant, and range of its concentrations, type of diluent, and selection of test organisms. Based on the literature review, two basic groups of methods used in studies of this kind are defined and characterized: (1) recording paralysis and death, and (2) recording physiological changes in organisms. Within the second group, three subgroups are described recording changes in (a) tissues and organs, (b) behavior and reflexes, and (c) physiological processes. The characteristics of the methods include their suitability for biological monitoring of the input of pollutants and for determining 'safe' concentrations of toxicants discharged into waters. Data on the standardization and normalization of such methods is presented. (Fish-PTT)
W89-10806

CULTURE TECHNIQUES FOR THREE FRESHWATER MACROINVERTEBRATE SPECIES AND THEIR USE IN TOXICITY TESTS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5A.
W89-10813

POLLUTION OF THE SEA: TOXICITY OF WATER-INSOLUBLE FUEL AND OF MERCURIC CHLORIDE (POLLUTION DU MILIEU MARIN TOXICITE DU FUEL ROSE ET DU DICHLORURE DE MERCURE),
Institut National Scientifique et Technique d'Oceanographie et de Peche, Salammbo (Tunisia).
O. Beji.
Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche BNSSEE, Vol. 12, p 53-61, 1985. 1 fig, 2 tab, 12 ref. English summary.

Descriptors: *Water pollution effects, *Toxicity, *Oil pollution, *Heavy metals, Mercuric chloride, Fish, Bioaccumulation.

In laboratory tests of the toxicity of mercuric chloride (0.001-50 mg/L) for salt water fish there was at first an apparent phase of inactivity. This phase corresponds to the time during which the mercury is absorbed and accumulated by the fish (sea bass, tuna, etc). The mercury compound operated slowly and its toxicity increased with time of exposure in the toxic solution (24 to 48 hr). The water insoluble fuel was found to be non-toxic in 24 to 48 h exposures, even for the maximal dose tested (2 ml/L). (Peters-PTT)
W89-10850

OIL SPILL DISPERSANT TOXICITY ON FISH AND MOLLUSC,
M. Belkhir, and M. Hadj Ali Salem.
Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche BNSSEE, Vol. 13, p 13-18, 1986. 1 fig, 6 tab, 4 ref.

Descriptors: *Oil spills, *Toxicity, *Dispersants, *Fish, *Mollusks, Lethal limit.

The toxicity of dispolene 32S (an oil spill dispersant) was tested on three kinds of fish (Mugil ramada Atherina hepsetus, Aphanius fasciatus) and two kinds of Mollusks (Mytilus gallaprovincialis and Tapes decussatus). Determination of LC-10, LC-50 and LC-90, the lethal concentration which kills 10%, 50% and 90%, respectively, of test organisms in 24 hours, shows that dispolene 32S is very toxic and can be considered as a harmful product even when used at low levels. The reaction time differs from one test organism to another; Mugil and Atherina were more sensitive than Aphanius and the mollusks were the most resistant of the organisms tested. It protects itself by withdrawing into itself. (Author's abstract)
W89-10852

TOXICITY OF THE DEGRADATION PRODUCTS OF TEEPOL, NEOCIDE, AND MERCURIC CHLORIDE ON ALEVINS OF SEA BASS AND MULLET (TOXICITE DES PRODUITS DE DEGRADATION DU TEEPOL DU NEOCIDE ET DU DICHLORURE DE MERCURE VIS-A-VIS DE ALEVINS DE LOUP DE DU MULET),
O. Benji, and M. Hadj Ali Salem.
Bulletin de l'Institut National Scientifique et Technique d'Oceanographie et de Peche BNSSEE, Vol. 13, p 79-88, 1986. 4 fig, 1 tab, 7 ref. English summary.

Descriptors: *Pesticides, *Mercury, *Toxicity, *Biodegradation, *Fish, *Heavy metals, Mortality, Laboratory studies, Bacteria.

Tests on the toxicity of Teepol, Neocide, and mercuric chloride conducted on alevins of sea bass and mullet in laboratory aquaria indicated that the toxicity decreases with the length of test time. Inactivation begins following a latent period during which the bacterial enzymes necessary for degradation are induced. After this period, the biodegradation is very fast for Teepol (3 days); longer for mercuric chloride (7 days), and Neocide (12 days). (Author's abstract)
W89-10853

INFLUENCE OF UREA TOP DRESSING OF FOREST WATER CATCHMENT AREAS ON THE BIOLOGICAL SUFFICIENCY AND

WATER QUALITY OF MOUNTAIN STREAMS. II. COMPOSITION, ABUNDANCE AND STRUCTURE OF THE BENTHIC COMMUNITIES (VLIYANIE NA TORENETO C UREYA NA GORSKI VODOSBARI VERKHI BIOLOGICHNATE P'LNOTSENNOST I KACHESVATA NA VODITE V PLANINSKI POTOTSI. II. SISTAV, OBILIE I STRUKTURA NA D'NNITE S'OBSHCHESTVA),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 5B.
W89-10856

HEAVY METAL INHIBITION OF RESTING NITRIFYING BACTERIA,
Purdue Univ., Lafayette, IN. Dept. of Environmental Engineering.
A. M. Ibrahim.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 309-311, 1 fig, 1 tab, 11 ref.

Descriptors: *Water pollution effects, *Toxic wastes, *Heavy metals, *Wastewater treatment, *Nitrification, *Bacteria, Nickel, Lead, Chromium, Microbiological studies, Biological treatment.

All heavy metals are potentially harmful to microorganisms at some level of exposure and absorption. Increased industrialization and domestic activities have accelerated the biogeochemical cycling of many elements, including heavy metals, causing increased deposition of elevated amounts of these metals into natural ecosystems, both aquatic and terrestrial. Unfortunately, it is known that nitrifying microorganisms are more susceptible to heavy metal inhibition than are the microorganisms primarily responsible for the oxidation of carbonaceous material. This study was developed to ascertain the relative susceptibility of nitrifying bacteria under resting versus active metabolic conditions by investigating the effect of the three metals (lead, nickel and chromium) upon the rate of respiration of resting and active nitrifying bacteria. Changes in respiration rate were used as the quantitative benchmark for inhibitory response, following one hour exposure periods. Lead appeared to be more inhibitive than nickel or chromium to the respiration rate of an enriched nitrifier culture. The inhibitory ranking of the three tested heavy metals appeared as follows: Pb < Ni < Cr. This observation was in general agreement with previous reports. Furthermore, direct comparisons of inhibition levels for active and resting nitrifiers show that the active cells have more relative sensitivity to these metals than during their substrate-limited resting stage. (See also W89-10858) (Lantz-PTT)
W89-10893

USE OF A BIOLOGICAL MEANDER TREATMENT SYSTEM FOR LEAD MINE/MILL WASTES IN SOUTHEAST MISSOURI, U.S.A.,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10924

ACID RAIN: THE RELATIONSHIP BETWEEN SOURCES AND RECEPTORS.
For primary bibliographic entry see Field 5B.
W89-10965

BIOLOGICAL INDICATORS OF FRESHWATER POLLUTION AND ENVIRONMENTAL MANAGEMENT,
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 5A.
W89-10986

CONTAMINATED WASTE SITES, PROPERTY AND YOUR HEALTH,
Lappenbusch Environmental Health, Inc., Alexandria, VA.
For primary bibliographic entry see Field 5E.
W89-10990

INTERACTIONS AMONG DRINKING AND GROUND WATER CONTAMINANTS ON RENAL AND HEPATIC FUNCTION,
Nebraska Univ., Omaha. Coll. of Medicine.
W. O. Berndt.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 075. Price codes: A04 in paper copy, A01 in microfiche. University of Nebraska Medical Center Report No. 87-213-042-01, July 1988. 63p, 3 append.

Descriptors: *Drinking water, *Synergistic effects, *Human pathology, *Water pollution effects, *Groundwater pollution, *Public health, *Kidneys, *Liver, Toxicity, Chromates, Sulfhydrls, Organic compounds, Monochloroacetate, Dichloroacetate, Dichloromaleate, Mercuric chloride, Chloroform, Hexachlorobutadiene, Maleic acid, Tissue analysis.

The intent of this proposal is to examine the effects of selected water pollutants and their interactions with chemicals known to produce liver or kidney damage. The chemicals selected for study are either ground or surface water contaminants, or are the by-products of chlorination, and hence are drinking water pollutants. The test compounds were selected on the basis of their potential for actions on the kidney or liver. The standard or reference substances to be used in these studies are known nephrotoxicants or hepato-toxicants. The specific aims of the project are: (1) to examine the effects of certain drinking and groundwater pollutants (monochloroacetate, dichloroacetate, dichloromaleate) on hepatic and renal function in dose-response studies with particular emphasis on low-dose and multiple-dosing protocols; and (2) to examine the effects of selected drinking and groundwater pollutants in conjunction with other drinking and groundwater pollutants or with substances known to be nephrotoxic and or hepatotoxic (e.g. mercuric chloride, chloroform, hexachlorobutadiene, maleic acid). Some of the interactions were of a potentiative nature and some were antagonistic. Chromate appears to enhance the nephrotoxicity of some of these test compounds. All of the studies suggest an important role in the tissue nonprotein sulfhydryls. (Lantz-PTT)
W89-10995

HEALTH AND ENVIRONMENTAL EFFECTS PROFILE FOR ETHYLBENZENE.
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W89-11000

COMPREHENSIVE COOLING WATER STUDY. FINAL REPORT: VOLUME IV, WETLANDS.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-010403. Price codes: A06 in paper copy, A01 in microfiche. Report No. DP--1739-4, September 1987. 170p, 58 fig, 49 tab, 88 ref. Edited by E. W. Wilde. DOE Contract DE-AC09-776SR00001.

Descriptors: *Savannah River Plant, *Wetlands, *Water pollution effects, *Thermal pollution, *Cooling water, Cypress trees, Tupelo trees, Vegetation, Nuclear reactors, Canopy, Swamps, Thermal stress, Temperature effects, Revegetation, Succession, Ecotypes, Reforestation, Remote sensing.

This volume describes the status of wetland plant communities on the Savannah River Plant (SRP), presenting maps of the major wetlands plant communities of the SRP and through the use of computerized geographic information (GIS) systems and remote sensing technologies gives the pattern and rate of historical changes in these wetlands. Plant community structure, diversity, biomass, and distribution of the wetland flora in thermal and non-thermal wetlands are presented. Effects of thermal effluents on the reproduction and survival or mortality of major components of the stream floodplains and swamp sites are presented. The most obvious effect of SRP cooling water releases on wetland plant communities is canopy loss by wetland tree species. About 1,020 hectare (ha) of wetland tree canopy exhibits some degree of alteration as a result of SRP cooling water releases. Canopy loss continues at a rate of 10 to 11 ha/yr in the Savannah River swamp areas associated with streams that receive reactor effluents (Pen Branch and Four Mile Creek). Closed canopy forest has been replaced by a mixture of wetland communities including submerged algal mat, thermally tolerant herbaceous plants, and scrub-shrub communities in the thermal streams and deltas. Studies of factors affecting reproduction and survival indicate that temperature and periodicity of flooding are important factors affecting survival of both mature trees and seedlings of both cypress and tupelo. Following cessation of thermal cooling water discharges, stream and delta areas are recolonized by a variety of herbaceous and scrub-shrub hardwood species. Successional processes in the post-thermal areas result in a shift from herbaceous dominated to shrub dominated wetland communities. Results from the Steel Creek Delta and the Beaver Dam Creek Delta indicate that reductions in effluent water temperatures and flows may also reverse the pattern of canopy loss and result in re-establishment of vegetation cover. However, the recovering wetland communities do not resemble the original cypress-tupelo forests. Little regeneration of cypress and tupelo has occurred. (See also W89-11003) (Lantz-PTT)
W89-11002

COMPREHENSIVE COOLING WATER STUDY. FINAL REPORT: VOLUME VII, ECOLOGY OF PAR POND.
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-010407. Price codes: A10 in paper copy, A01 in microfiche. Report No. DP--1739-7, October 1987. 215p, 31 fig, 65 tab, 223 ref, append. Edited by E. W. Wilde. DOE Contract DE-AC09-76SR00001.

Descriptors: *Ponds, *Cooling water, *Ecology, *Water pollution effects, *Thermal pollution, Par Pond, Aquatic environment, Ecological effects, Water temperature, Fish, Primary productivity, Seasonal variation, Savannah River, Phosphorus, Nitrates, Silica, Potassium, Magnesium, Calcium, Sodium.

The major effects of P-Reactor operations on the aquatic ecology of Par Pond were associated with the introduction of Savannah River makeup water into Par Pond, pumping activities at the intake structure, and the addition of thermal effluents into Par Pond. Par Pond had significantly greater mean concentrations of total phosphorus, nitrate, silica, potassium, magnesium, calcium, sodium, chloride, inorganic carbon, and total dissolved solids than Pond B. This was attributed to increased concentrations of these chemicals from the Savannah River makeup water pumped into Par Pond. The pumping of Savannah River water into Par Pond during periods when P-Reactor was not operating appeared to be responsible for the introduction of several species into Par Pond including the macrophytes, the asiatic clam, the caddisfly, the anadromous blueback herring, and various phytoplankton and zooplankton. Higher primary productivity in the Hot Arm of Par Pond was attributed to higher water temperatures and greater availability of nutrients in that area. As a result of the higher primary production in the Hot Arm, there was more food available for each successive level of the food chain in this region. The elevated primary productivity rates resulted in a greater abundance of benthic macroinvertebrates and macrozooplankton, which created more food for bluegill and other forage fish. During the summer, water temperatures near the Hot Dam exceeded the water temperatures preferred by largemouth bass, black crappie, and bluegill. However, these species still congregated there, possibly because of a greater availability of food in this region. During the winter, species-specific preferences for the higher temperatures in the Hot Arm may have attracted largemouth bass, bluegill, and black crappies. Although the operation of P reactor affected the aquatic ecology of Par Pond, the present levels of thermal and chemical enrichment from cooling

water entering Par Pond along with the entrainment at the Par Pond pumphouse have not caused significant adverse impacts on the flora and fauna of Par Pond. The primary producer, invertebrate, and vertebrate communities of Par Pond have remained diverse, balanced, and representative of the region. (See also W89-11002) (Lantz-PTT)
W89-11003

RECONNAISSANCE SURVEY OF EIGHT BAYS IN PUGET SOUND,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. A. Strand, E. A. Crecelius, W. H. Fearson, G. W. Fellingham, and R. E. Elston.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-008186. Price codes: A03 in paper copy, A01 in microfiche. Report No. PNL-SA--15393, March 1988. 9p, 2 fig, 6 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Puget Sound, *Water pollution effects, *Surveys, Toxicity, Sediment contamination, Bioassay, Fish, Crustaceans, Mollusks.

From 1983 to 1985, Battelle/Marine Research Laboratory conducted reconnaissance-level field and laboratory studies to better characterize toxic contamination problems occurring in selected urban-industrialized bays (Bellingham Bay, Port Gardner-Everett Harbor, Fourmile Rock--Elliott Bay dump site vicinity, Sinclair Inlet) of Puget Sound. It was envisioned that this goal was best achieved by simultaneously determining levels of contamination in selected baseline or 'reference bays' (Samish Bay, Case Inlet, Dabob Bay, Sequim Bay). Two major tasks composed this effort. The first was conducted in 1983 and consisted of preliminary or screening surveys to collect and analyze sediment samples from 101 stations distributed in the four urban-industrialized bays, and at 80 stations distributed in the four baseline bays. The second task was undertaken in 1984 and involved detailed surveys and analyses of the same bays, but at a limited number of stations (32 in urban embayments, 16 in baseline bays). A summary of the results of the 1984 detailed surveys is given in this paper: a description of each urban and baseline bay in terms of its bathymetry and sediment chemistry, sediment toxicity, numerically dominant benthic infauna, incidence of fish and shellfish disease, and amphipod and oyster larval bioassays it discussed in relation to the physical and chemical properties of associated sediments. The embayments and the stations in each embayment that showed signs of degraded sediment quality are also identified. (Lantz-PTT)
W89-11010

SOME OBSERVATIONS OF EFFECTS FROM POLYCYCLIC AROMATIC HYDROCARBONS (PAH) AND FLUORIDE IN NORWEGIAN MARINE RECIPIENTS OF ALUMINUM SMELTER WASTE,
Norsk Inst. for Vannforskning, Oslo.
J. Knutzen.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-752846. Price codes: A03 in paper copy, A01 in microfiche. Report No. NIVA-E--87700/II, May 4, 1987. 28p, 10 fig, 4 tab, 31 ref.

Descriptors: *Marine animals, *Industrial wastes, *Aluminum, *Coastal waters, *Water pollution effects, *Algae, *Hydrocarbons, *Fluorides, *Norway, Industrial wastewater, Marine environment, Ecological effects, Mussels, Snails, Aquaculture, Bioaccumulation, Aromatic compounds, Gastropods.

Observations in Norwegian marine recipients of aluminum smelter waste have only shown marked ecological effects in the near zone (< 1 km) of scrubber effluents or in the vicinity of deposits rich in polyaromatic hydrocarbons (PAHs) and fluoride. However, 1-3 orders of magnitude excess concentrations of PAH in mussels, snails and seaweeds have been observed at distances > 20 km from the sources, imposing restrictions on aquaculture in a considerable fjord area. Fluoride concentrations about 5 times the 'normal' level have been observed in seaweeds exposed to less than the double natural fluoride content of water. No significant contamination was recorded in limpets. (See also W89-11014) (Author's abstract)
W89-11013

SOURCES, OCCURRENCE AND EFFECTS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE AQUATIC ENVIRONMENT-A PRELIMINARY REVIEW,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5B.
W89-11014

5D. Waste Treatment Processes

NUTRIENT REMOVAL FROM SECONDARY EFFLUENT BY FILAMENTOUS ALGAE,
Osaka Univ., Suita (Japan). Faculty of Engineering.
S. Hashimoto, and K. Furukawa.
Journal of Fermentation and Bioengineering JFBIEX, Vol. 67, No. 1, p 62-69, January 1989. 15 fig, 3 tab, 16 ref.

Descriptors: *Wastewater treatment, *Effluents, *Algae, *Secondary wastewater treatment, *Sludge utilization, *Culturing techniques, *Nutrient removal, Secondary wastewater, Activated sludge, Filtration, Oscillatoria, Proteins.

The nutrient removal potential of filamentous Oscillatoria sp. was quantitatively studied. Oscillatoria sp. showed satisfactory growth on secondary activated sludge effluent supplemented with 1% NaHCO3. Continuous open culture of Oscillatoria ap. was kept stable using a continuous stirred tank equipped with a filter-separator. Kinetic constants Y sub N and Y sub P were 10.6 g cells/g NO3-N and 37.7 g cells/g PO4(-3), respectively, through the analysis of the results of continuous culture experiments. Monoalgal continuous culture of more than 90% purity could be maintained for six months without contamination. The harvested Oscillatoria cells were proven to have an excellent filterability. They also have excellent autoflotation. The amino acid composition of the Oscillatoria algal protein compares favorably with the tentative standard for ideal protein defined by the United Nations Food and Agricultural Organization and World Health Organization. (Author's abstract)
W89-10552

AEROBIC SLUDGE STABILIZATION: FACTORS AFFECTING KINETICS,
Jacobs Engineering Group, Inc., Houston, TX.
R. Krishnamoorthy, and R. C. Loehr.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 283-301, April 1989. 8 fig, 4 tab, 24 ref.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Primary sludge, *Activated sludge, Temperature effects, Hydrogen ion concentration, Sludge digestion, Activated sludge process, Kinetics.

The effects of temperature, pH, sludge age in the prior activated sludge process, initial sludge solids concentration, and sludge type on the rate of solids degradation during aerobic sludge stabilization were studied. Primary sludge (PS), waste activated sludge (WAS), and mixed primary and waste activated sludges (PS/WAS) were stabilized. The results indicate that: (1) First-order kinetics satisfactorily describe biodegradable volatile solids (BVS) degradation for WAS and mixed PS/WAS, but not for PS; (2) the BVS decay coefficient b increases with increasing temperatures between 10 to 30 C with a thermal coefficient of 1.097; (3) b values decrease as the sludge age in the prior activated sludge process increases; (4) b values are higher at reactor pH values > or = 6.5; and (5) b values tend to decrease as the initial volatile solids concentration of the sludge increases. The WAS had initial BVS and refractory volatile solids (RVS) content of 44-67% and 33-56%, respectively; the mixed PS/WAS contained 33-40% and 60-67%, respectively; and the PS had contents of 74-91% and 9-26% respectively. The WAS had less biodegradable solids and a greater percent of residual refractory volatile solids requiring disposal than did the PS. (Author's abstract)
W89-10574

INHIBITORY SUBSTRATE UTILIZATION BY STEADY-STATE BIOFILMS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W89-10575

EFFECT OF CONCENTRATION BOUNDARY LAYER ON CARBON LIMITED ALGAL BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W89-10576

EFFECTS OF PREOZONATION ON ANAEROBIC BIODEGRADABILITY OF O-CRESOL,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
Y. T. Wang, P. C. Pai, and J. L. Latchaw.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 336-347, April 1989. 10 fig, 1 tab, 15 ref. US Dept. of the Interior Project 87-03.

Descriptors: *Wastewater treatment, *Cresols, *Biological wastewater treatment, *Ozonation, *Phenols, *Anaerobic digestion, *Biodegradation, Degradation products, Methane, Organic acids, Toxicity, Culturing techniques, Bioassay, Biochemical tests, Chemical oxygen demand, Dissolved solids, Inhibition.

Wastewaters containing phenols have been treated by physical,l chemical, and biological methods. Although a range of phenolic compounds has been reported to be biodegradable to methane, most of these materials are toxic and resistant to anaerobic biodegradation or require a prolonged period of acclimation. Ozone pretreatment studies of a refractory phenolic compound, o-cresol, were conducted to evaluate the effects of ozonation on the anaerobic biodegradability and toxicity of the reaction products. Two types of batch studies, the biochemical methane potential (BMP) and the anaerobic toxicity assay (ATA), were performed on samples with and without preozonation. The ozonation products were well fermentable to methane after about 60% reduction in chemical oxygen demand (COD) or 32% reduction in dissolved organic carbon (DOC) was achieved by ozonation regardless of the initial concentration of o-cresol. Salicylic acid, glyoxylic acid, oxalic acid, propionic acid, acetic acid, and formic acid were the oxidation products identified. The reaction products formed in the basic pH range were more biodegradable and less inhibitory than those formed in the acid pH range. Phenol degradation was more susceptible to inhibition caused by ozonation products than was acetate utilization. (Ver-Nooy-PTT)
W89-10577

EFFICIENT ELIMINATION OF ORGANIC LIQUID WASTES: WET AIR OXIDATION,
Institut National des Sciences Appliquees, Toulouse (France). Dept. 'Genie des Procedes Industriels'.
J. N. Foussard, H. Debellefontaine, and J. Bescombes-Vailhe.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 367-385, April 1989. 9 fig, 3 tab, 20 ref.

Descriptors: *Wastewater treatment, *Wet oxidation process, *Liquid wastes, *Waste disposal, *Chemical degradation, *Industrial wastes, *Fuel, Temperature, High pressure, Chemical wastes, Pulp wastes, Sludge, Organic wastes, Carbon dioxide, Acetic acid, Data collections, Process control.

Wet air oxidation is ideally suited to liquid wastes which are too dilute to be incinerated and too

refractory to be handled by chemical or biological oxidation. This process relies on high temperature (470-600 K) and pressure (2-20 mPa) conditions for oxidation of the organic substances by molecular oxygen in the liquid phase. Several types of industrial wastes, mainly paper-mill black liquors, biological sludges, and acidic organic wastes, have been tested for oxidation in a batch reactor. This research provides evidence for the high efficiency of the wet air oxidation process for the transformation of most of the pollutants to carbon dioxide. An average removal efficiency of 98% was obtained. As acetic acid is the main intermediate appearing during oxidation of the heavier organics, the study of the behavior of sodium acetate under treatment conditions enabled the most efficient oxidation conditions to be determined from numerous wastes. The various data available are compiled in a general chart which makes a quick determination of the working conditions possible for any indexed waste. Moreover, it has been established that a continuous process usually leads to a net production of energy. It is believed that this research is the first step in the design of a large-scale wet air oxidation unit. (Author's abstract)
W89-10579

TREATMENT OF MANGANESE FROM MINING SEEP USING PACKED COLUMNS,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-10580

MODELING PHOSPHORUS TRANSPORT IN GRASS BUFFER STRIPS,
Georgia Univ., Athens. Inst. of Ecology.
D. Lee, T. A. Dillaha, and J. H. Sherrard.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 40-427, April 1989. 7 fig, 3 tab, 27 ref.

Descriptors: *Phosphorus removal, *Solute transport, *Grassed waterways, *Filter crops, *Land disposal, *Water pollution treatment, *Surface runoff, *Wastewater treatment, *Computer models, *Phosphorus, *Surface detention, Water pollution prevention, Grasses, Computer programs, Advection, Infiltration, Nutrient removal, Rainfall, Soil properties, Field tests, Nutrients, Model testing, Simulation.

An event-based computer model, GRAPH, was developed to simulate phosphorus (P) transport in grass buffer strips (GBS) by incorporating submodels into SEDIMOT II, a stormwater and sediment transport model developed for strip mine reclamation. GRAPH considers the effects of advection processes, infiltration, biological uptake, P desorption from the land surface to runoff, adsorption of dissolved P to suspended solids in runoff, and the effects of changes in sediment size distribution on P transport. Required input data include: rainfall intensity and duration, an inflow hydrograph, a sediment graph, sediment size distribution, GBS dimensions and hydraulic characteristics, inflow graphs for dissolved P, P desorption and adsorption reaction coefficients for soil and plant matter, and the P content of each soil particle size class. GRAPH simulates time varying infiltration, run off discharge, sediment yield, particle size distribution, and dissolved and sediment-bound P discharge along with sediment and P trapping efficiencies in GBS. GRAPH was verified using data from experimental field plots. Model prediction and observed P transport in the GBS compared favorably. (Author's abstract)
W89-10581

ANALYTICAL APPROACH FOR EVALUATION OF SETTLING COLUMN DATA,
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
H. A. San.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 455-461, April 1989. 1 fig, 2 tab, 10 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Settling tanks, *Consolidation sedimentation, *Sedimentation rates, *Settling velocity, Mathematical equations, Flocculation, Clays, Experimental data, Design criteria, Least squares method, Performance evaluation, Computer-aided design.

Sedimentation is one of the main operations of water and wastewater treatment. Settling column tests are recommended for the rational design of sedimentation tanks. An adequate mathematical equation describing the settling properties of the suspension will simplify the design procedure, and enable application of computer techniques. An empirical equation, containing three parameters, for iso-percentage curves is developed for quiescent settling of suspensions. The equation reflects the behavior of iso-percentage curves and its validity is verified by using experimental data reported in reliable references. A flocculation coefficient, alpha, is also defined by means of these parameters to characterize suspensions. An expression in a convergent series form is obtained in order to determine overall-solids removal efficiency. The proposed technique, based on the method of least squares, provides a unified procedure to derive iso-percentage curves and to determine the overall solid removal efficiencies. It is not restricted to regions of the settling data, and it also minimizes possible errors. (VerNooy-PTT)
W89-10584

SINGLE-CELL PROTEIN FROM WASTEWATER OF MONOSODIUM GLUTAMATE MANUFACTURE,
Shanghai Brewing Scientific Research Inst. (China).
H. Yiao.
Process Biochemistry PRBCAP, Vol. 23, No. 6, p 176-177, December 1988. 4 tab, 8 ref.

Descriptors: *Wastewater treatment, *Proteins, *Biological wastewater treatment, *Industrial wastewater, *Yeasts, Single-cell protein, Monosodium glutamate, Fungi, Chemical oxygen demand, Biological oxygen demand.

Five species of yeast were used to treat the wastewater from a monosodium glutamate manufacturing plant: Candida tropicalis, C. utilis, Geotrichum candidum, Saccharomyces cerevisiae, and S. fermentati. Candida yeasts were found to be the best suited for growth on the wastewater, giving better yields and utilizing more reducing matter than the other two genera. For C. tropicalis, the chemical oxygen demand and biological oxygen demand were reduced by 69% and 54% respectively while producing a single-cell protein containing 54.4% protein. (Author's abstract)
W89-10623

STABILITY OF AN ANAEROBIC PERCOLATING FILTER DURING SUCCESSIVE FEED CHANGES, AND ORGANIC AND HYDRAULIC OVERLOADINGS,
Murcia Univ. (Spain). Dept. of Biochemistry and Molecular Biology.
J. J. Bermudez, A. Jimeno, M. Canovas-Diaz, A. Manjon, and J. L. Iborra.
Process Biochemistry PRBCAP, Vol. 23, No. 6, p 178-181, December 1988. 2 fig, 3 tab, 16 ref. Grant GG85-0142 CAICYT, Spain.

Descriptors: *Wastewater treatment, *Food wastes, *Canneries, Biological wastewater treatment, *Biofilters, *Anaerobic digestion, *Industrial wastewater, Fixed bed reactor, Percolating filter.

Two successive feed changes (pear-canning industry effluent and high strength cheese whey) were made on a downflow stationary fixed-film reactor operated as a percolating filter (anaerobic trickling filter), which had been started up with glucose as the limiting substrate. Results showed satisfactory stability against substrate changes, organic and hydraulic overloading, and a combination of all these conditions. Theoretical and experimental conversions were well over 60% for all cases. pH and gas composition were consistent throughout the experiments. The reactor could perform successfully with both diluted and concentrated wastes under realistic operational conditions. (Author's abstract)
W89-10624

USE OF OZONE AND FLUIDIZED-BED BIOFILTERS FOR INCREASED AMMONIA REMOVAL AND FISH LOADING RATES,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
For primary bibliographic entry see Field 8I.
W89-10626

IMPROVEMENTS IN THE ACTIVATED SLUDGE PROCESS IN THE U.K. AND U.S.
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
M. J. Healey.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 446-451, April 1989. 7 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Aeration, Model studies, Nitrification, Computer models, Wastewater oxidation, Economic aspects, Design criteria, Prediction, Costs, Economies of scale, Foreign design practices.

A large number of treatment works are facing increasing demands to optimize plant performance as a result of having to meet higher effluent standards, reduce operating costs, and treat greater volumes of waste. The most costly process in the activated sludge treatment of wastewater is usually aeration. In a well designed activated sludge system, the oxygen supply rate is proportional to the changing process requirements. An inherent difficulty in building an efficient activated sludge plant as part of an entirely new sewage treatment words is that the success of optimization depends on the input conditions of sewage flowrate and strength being well defined. The Water Research Centre (WRc) in the U.K. has developed a dynamic model of the activated sludge process in the form of a computer simulation that can be used interactively by a plant designer. This model accurately predicts sludge production and the degree of nitrification and the oxygen requirements in all positions in the aeration tank. The simulation results also permit the selection of an effective DO control system that will adjust aeration rates during diurnal and seasonal changes in inlet water quality. The basis of the WRc design technique is to predict, with the aid of computer modeling, the configuration or motor size of the aeration equipment that is best suited to process requirements. The cost of modifications to existing treatment works must be balanced by a potential annual savings in energy costs. However, as the size of the treatment plant facility increases, the potential saving becomes increasingly attractive. (White-Reimer-PTT)
W89-10628

NITRIFICATION OF ACTIVATED SLUDGE EFFLUENT IN A CROSS-FLOW MEDIUM TRICKLING FILTER SYSTEM,
General Environmental Consultants, Englewood, NJ.
J. M. Huang, O. J. Hao, Y. C. Wu, and A. H. Molof.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 461-469, April 1989. 8 fig, 3 tab, 26 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Trickling filters, *Nitrification, Ammonium chloride, Sodium biocarbonate, Ammonium, Mathematical models, Regression analysis, Nitrites, Chemical treatment, Effluents.

Nitrification of the activated sludge effluent was performed in a cross-flow plastic medium trickling filter system. The trickling filter influent was supplemented with ammonium chloride and sodium biocarbonate. The effluent ammonium concentration was significantly affected by the flow rate, ammonium loading, and the influent ammonium concentration. Nitrite accumulation in the trickling filter system was significant, and the nitrite concentration was related to the influent ammonium

loading and the effluent ammonium concentration. Nitrification was severely reduced when the ratio of the influent alkalinity to the ammonium nitrogen concentration was less than 7.1. If subsequent denitrification is required, it is recommended that fixed-film nitrification for a relatively high influent ammonia concentration be used to generate the nitrite. A multiplicative regression model appears to be the best fit for the prediction of nitrification efficiency for this study. However, full-scale studies for separate nitrification are required to verify the validity of the empirical equation obtained from this study. (White-Reimer-PTT)
W89-10629

METALS REMOVAL IN OVERLAND FLOW,
Dames and Moore, Atlanta, GA.
J. Zirschky, D. Crawford, L. Norton, and D. Deemer.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 470-475, April 1989. 1 fig, 7 tab, 16 ref.

Descriptors: *Wastewater treatment, *Overland flow, *Metals, *Heavy metals, Secondary wastewater, Copper, Zinc, Potassium, Calcium, Advanced wastewater treatment, Soil chemistry, Sampling, Texas.

Metals removal from advanced secondary quality wastewater was evaluated for 1 year in the city of Garland, Texas. Application rates of 0.17, 0.31, 0.45, and 0.57 cu m/m/min were tested and did not appear to effect metals removal. Only copper and zinc were consistently removed at all application rates. An exchange of wastewater potassium with calcium in the soil also occurred, thereby increasing effluent calcium concentrations. A recommended conservative approach is either to assume that no metals removal will occur in overland flow and design for metals removal in preapplication treatment, or to conduct pilot testing. A high sampling frequency and close sample location spacing should be used in pilot test programs. Because metals removal occurs by soil adsorption and precipitation, metals removed by overland flow will build up in soil. Therefore, soils at an overland flow system should be routinely monitored for metals buildup. Periodic monitoring for metals every 3 to 5 years after the first year is a reasonable guideline. (White-Reimer-PTT)
W89-10630

ACTIVATED SLUDGE RESPONSE TO A PARACHLOROPHENOL TRANSIENT,
Akron Univ., OH. Dept. of Civil Engineering.
W. B. Arbuckle, and M. S. Kennedy.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 476-480, April 1989. 4 fig, 3 tab, 9 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Parachlorophenol, Synthetic waste, Acclimatization, Sludge, Chemical oxygen demand, Effluents, Contamination, Inhibition.

Effluent quality and operational problems caused by wastewater contaminant inhibition of activated sludge were studied. In laboratory reactors, activated sludge was subjected to parachlorophenol (p-chlorophenol) loading transients, where p-chlorophenol (50 mg/L) was omitted from a complex synthetic waste feed for periods up to 7 days. The ability of the sludge to degrade p-chlorophenol decreased in the experiments faster than that indicated by calculations in which cell wash-out, based on mean cell residence time, was considered. Data also showed that after losing its acclimation, a reactor reacclimated within 2 days. When p-chlorophenol was removed from the complex waste feed, effluent soluble COD increased even though feed COD decreased. Specific chemical analysis showed little p-chlorophenol leakage except when it was reintroduced into the reactor after several days of absence. A second interruption in p-chlorophenol fed to an activated sludge reactor causes more dramatic adverse effects than the first interruption. (White-Reimer-PTT)
W89-10631

REGENERATION AND REUSE OF IRON HYDROXIDE ADSORBENTS IN TREATMENT OF METAL-BEARING WASTES,
Washington Univ., Seattle. Dept. of Civil Engineering.
M. Edwards, and M. M. Benjamin.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 481-490, April 1989. 8 fig, 5 tab, 8 ref. U.S. E.P.A. Grant No. R810902-01-2.

Descriptors: *Metal finishing wastes, *Adsorbents, *Wastewater treatment, *Iron hydroxide, *Physicochemical treatment, Precipitation, Adsorption, Metals, Heavy metals, Sludge, Metal recovery, Economic aspects, Operating costs.

Sludge from a treatment process using iron was exposed to a mildly acidic solution to investigate iron hydroxide's capacity to collect metals from waste by comparing several aspects of two treatment processes; hydroxide precipitation and adsorption to ferrihydrite. In general, ferrihydrites removed an equal or greater percentage of soluble Cu, Cd, Zn, Cr(III), Ni, and Pb from a synthetic-waste solution at all pH's. Batches of iron hydroxide were regenerated and reused 50 times to treat both synthetic and real plating waste. Treatment efficiency was very high and steady, and there was no indication of deterioration in any aspect of process performance. Over time, the treated metals were concentrated in the regenerant solution and may be recoverable. The acid and base requirements were comparable to those for conventional coagulation. Overall, the process appears promising for metal treatment, sludge minimization, and possibly metal recovery. Differences in chemical costs between adsorption with regeneration and precipitation are not very significant. As regeneration effectively separates ferrihydrite from any sludge that may be produced, it now appears possible to attain the advantages of adsorption without significant economic cost. (White-Reimer-PTT)
W89-10632

FATE OF THE DETERGENT BUILDER, SODIUM POLYGLYOXYLATE, IN WASTEWATER TREATMENT,
Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering.
J. K. Park, D. Jenkins, T. M. Holsen, T. W. Warnock, and W. E. Gledhill.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 491-499, April 1989. 13 fig, 2 tab, 15 ref.

Descriptors: *Wastewater treatment, *Sodium polyglyoxylate, *Detergents, *Wastewater renovation, *Phosphates, Activated sludge, Primary wastewater treatment, Anaerobic digestion, Sludge drying, Water transport, Sludge digestion, Retention time.

Laboratory-scale experiments were conducted to investigate the fate of a potential polyphosphate substitute, sodium polyglyoxylate (SPG), in synthetic detergents during sewer transport, primary sedimentation, activated sludge, anaerobic digestion, and sludge dewatering. SPG removal from typical domestic wastewater was influenced by SPG distribution between dissolved and suspended states. Suspended SPG species were removed proportionally with suspended solids during primary sedimentation, and suspended SPG escaping primary sedimentation became incorporated into the activated sludge and was removed with the waste activated sludge. Significant SPG hydrolysis and biodegradation occurs during anaerobic digestion of the sludges with a hydraulic retention time of 20 days (37% of the SPG carbon was converted to CH4 and CO2). It was estimated that 10% sludge SPG biodegraded during a 10-day drying period in a sludge drying bed. For shorter sludge drying times and for mechanical dewatering no biodegradation can be assumed. Materials balance calculations indicate SPG removals of 67 to 76% of which 22 to 27% of influent SPG remained in dried digested sludge. (Author's abstract)
W89-10633

DIFFUSION'S ROLE IN REGULATING RATE AND MASKING TEMPERATURE EFFECTS IN FIXED-FILM NITRIFICATION,
C.R.M., Draper, UT.
R. W. Okey, and O. E. Albertson.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 500-509, April 1989. 12 fig, 1 tab, 38 ref.

Descriptors: *Wastewater treatment, Tertiary treatment, *Nitrification, Data analysis, Oxidation, Hydraulic loading, Fixed-film theory, Temperature effects, Kinetics, Reaction rates, Ammonia, Diffusion.

Data from eight tertiary facilities were analyzed in order to develop design procedures which could be supported by the theory of oxidation in fixed biological films. The study was particularly directed toward the actual kinetics of NH4-N oxidation under varying operating conditions, the origin of temperature effects, and the impact of varying hydraulic load. Basic fixed-film theory was used as the basis for formulating procedures for data reduction and analysis. It was concluded that: (1) reaction rate changes with temperature seem to be controlled by changes in the rate at which critical substrates reach reaction sites; (2) the application of an Arrhenius-type correction for rate differances derived from an increase or decrease in temperature is probably invlaid; (3) there seem to be two kinetic regions operating in most fixed-film towers designed for the tertiary treatment of wastewater; (4) there seems to be little or no effect derived from varying the hydraulic loading from 0.34 to 1.70 L/sq m/sec as long as the NH4-N load is kept below 1.2 g/sq m/d; (5) the design of natural draft towers cannot be undertaken with any confidence at loadings greater than 1.2 g/sq m/d; and (6) crossflow, vertical flow, and high density (230 sq m/cu m) media produced essentially the same rates in the loading area below 1.2 g/sq m/d). (See also W89-10635) (White-Reimer-PTT)
W89-10634

EVIDENCE FOR OXYGEN-LIMITING CONDITIONS DURING TERTIARY FIXED-FILM NITRIFICATION,
C.R.M., Draper, UT.
R. W. Okey, and O. E. Albertson.
Journal Water Pollution Control Federation JWPFA5, Vol. 61, No. 4, p 510-519, April 1989. 8 fig, 1 tab, 33 ref.

Descriptors: *Wastewater treatment, *Tertiary treatment, *Nitrification, Data analysis, Oxidation, Hydraulic loading, Fixed-film theory, Temperature, Kinetics, Reaction rates, Ammonia, Oxygen demand.

An analysis of data from five pilot tertiary treatment plant facilities has been carried out in order to evolve design procedures which could be supported by the theory of oxidation in fixed biological films. The study was particularly directed toward the resolution of questions about the actual kinetics of NH4-N oxidation under varying operating conditions, the impact of DO levels on NH4-N removal rate, the origin and magnitude of temperature effects, and the impact of varying the hydraulic load. It was concluded that: (1) all tertiary towers studied, when loaded at rates greater than 1.2 g/sq m/d of NH4-N, periodically demonstrated an oxygen deficient condition, as evidenced by a reduced rate and extent of oxidation ; (2) there seem to be two kinetic regions operating in most fixed-film towers designed for the tertiary treatment of wastewater; (3) the temperature effects seem to be comparatively minor in the zero-order region because of the offsetting effects of temperature of diffusivity of oxygen on the concentration of oxygen possible in the bulk-liquid flow; (4) the effect of hydraulic loading seems to be complex and the data available do not serve to completely resolve the question of the impact of hydraulics on the system; (5) a single oxidation rate (g/sq m/d) or inverse areal loading rate (sq m/g/d) does not constitute a rational basis for design; and (6) although the evidence is indirect, it is clear that NH4-N and oxygen diffusion control or limit nitrification rate and that temperature effects are mini-

mal across the entire range of normal loadings. (See also W89-10634) (White-Reimer-PTT)
W89-10635

DETERGENT FORMULA AND CHARACTERISTICS OF WASTEWATER IN SEPTIC TANKS,
Wisconsin Univ., Madison. Water Resources Center.
B. J. Alhajjar, J. M. Harkin, and G. Chesters.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 605-613, May 1989. 1 fig, 7 tab, 16 ref. U.S. Department of the Interior, Bureau of Reclamation contract 14-34-0001-0257.

Descriptors: *Wastewater analysis, *Septic wastewater, *Septic tanks, *Biological wastewater treatment, *Detergents, Phosphates, Carbonates, Nitrates, Alkalinity, Temperature, Sodium, Potassium, Calcium, Magnesium, Chlorides, Conductivity, Biological oxygen demand, Bacteria.

Septic system treatment of wastewaters containing phosphate-built or carbonate-built detergents was evaluated. For two years, monthly effluent samples were taken from 17 household septic systems and were analyzed for physical, chemical, and biological parameters. Wastewater loads to each septic system were measured and detergent use and laundering activity records were kept. The data were statistically evaluated. Results showed surfactants were degraded in the septic tanks. Alkalinity, temperature, Na, K, Ca, Mg, Cl, Na absorption ratio, electrical conductivity, solids, biological oxygen demand, and counts of indicator bacteria were higher in wastewater with phosphate-built detergent use. The use of phosphate-built detergent significantly increased the total P load in effluents. However, better removal of total N was achieved with the use of phosphate-built detergent. The carbonate-built detergent increased the buffer capacity of wastewater; no significant differences in pH were found in the two types of wastewaters resulting from detergent use. (Author's abstract)
W89-10694

EFFECT OF AMMONIA ON COD ANALYSIS,
General Motors Research Labs., Warren, MI.
For primary bibliographic entry see Field 7B.
W89-10695

ENHANCING REACTION RATES IN NITRIFYING TRICKLING FILTERS THROUGH BIOFILM CONTROL,
Brown and Caldwell, Walnut Creek, CA.
D. Parker, M. Lutz, R. Dahl, and S. Bernkopf.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 618-631, May 1989. 10 fig, 3 tab, 19 ref.

Descriptors: *Biological wastewater treatment, *Trickling filters, *Wastewater treatment, *Nitrification, *Biofilms, Tertiary wastewater treatment, Predation, Model studies.

Reaction rates in tertiary nitrifying trickling filters have been significantly increased by the development of the biofilm-controlled nitrifying trickling filter (BCNTF). The use of cross-flow media in the BCNTF permits higher oxygen transfer to the biofilm than does the older vertical media. The use of a flooding cycle prevents the growth of predator organisms that have consumed the biofilm in other plants and have disrupted nitrification. A backwash feature controls biomass inventory and eliminated the need for subsequent clarification. Operation and maintenance and capital costs are often less than for other processes. A design model has been developed that accurately predicts performance. (Author's abstract)
W89-10696

TOXICITY SCREENING IN A LARGE, MUNICIPAL WASTEWATER SYSTEM,
Jacksonville Dept. of Public Utilities, FL. Wastewater Div.
C. L. Logue, B. Koopman, G. K. Brown, and G. Bitton.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 632-640, May 1989. 9 fig, 2 tab, 8 ref. NSF grant CES-8619073 and Florida Department of Environmental Regulation contract WM-222.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Wastewater analysis, *Toxicity, *Bioassay, Sedimentation, Activated sludge, Daphnia, Escherichia coli, Photobacterium, Bioluminescence, Enzymes.

A 15-month study was conducted to identify sources of toxic wastewater in a 1.8 cu m/s (41 mgd) collection system. Samples from various points in the system were treated by sedimentation and activated sludge. Samples were then tested by Daphnia pulex 48-h acute bioassay as well as three alternative microbioassays. Several sources of highly toxic wastewater in the collection system were identified. In most cases, toxicity decreased or was eliminated by activated sludge treatment. Wastewaters not amenable to biological detoxification were generally from industrial areas. Two of the microbioassays, sludge dehydrogenase activity and enzyme biosynthesis in wild type Escherichia coli, were insensitive to wastewater toxicity for D. pulex. The third, which was based on bioluminescence of Photobacterium phosphoreum, was a useful adjunct to the D. pulex bioassay. (Author's abstract)
W89-10697

AQUATIC WASTEWATER TREATMENT USING ELODEA NUTTALLII,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
P. L. Bishop, and T. T. Eighmy.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 641-648, May 1989. 6 fig, 2 tab, 51 ref. NSF grant CEE-8209851.

Descriptors: *Filter crops, *Wastewater treatment, *Biological wastewater treatment, *Aquatic plants, *Elodea, Biochemical oxygen demand, Ammonium, Nitrogen, Phosphorus.

The feasibility of using aquatic macrophyte-based aquatic treatment systems to treat wastewater in temperate climates was examined. Elodea nuttallii, Myriophyllum heterophyllum, and Lemna minor were selected for study. E. nuttallii grew in primary effluent year-round, and effectively treated the wastewater to advanced secondary and possibly tertiary water quality levels. E. nuttallii-based systems that operated on a pilot-scale continuous flow basis for 2 years were able to remove an annual average of 90% of the 5-day biochemical oxygen demand (BOD), 75% of the ammonia, 47% of the total N, and 38% of the total P from the primary wastewater. Control reactors without macrophytes removed 67% of the BOD, 22% of the ammonia, less than 4% of the total N, and less than 19% of the influent P. Hydraulic retention times of 2.5 to 3.5 days were required in the E. nuttallii reactors. Removal rates were usually significantly correlated to plant biomass and productivity. (Author's abstract)
W89-10698

FINE BUBBLE AERATION: MATHEMATICAL MODELING OF TIME-DEPENDENT OPERATION,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
D. J. Wilson.
Separation Science and Technology SSTEDS, Vol. 23, No. 14/15, p 2211-2230, Nov/Dec 1988.

Descriptors: *Model studies, *Aeration, *Wastewater treatment, *Mathematical models, Mass transfer, Kinetics, Bubbles.

Steady-state models are very useful for the engineer designing an aeration facility for the treatment of influent streams having relatively constant flow rates and compositions. In the treatment of wastewaters, however, one is typically confronted with influent streams which are highly variable in both flow rate and composition. In this study, the operation of fine bubble aeration columns in the time-dependent mode was modeled. The kinetics of mass transfer between the solution and the rising bubbles was included by means of a time-constant approach. The magnitude of delta t is limited by the requirement that u sub w times delta t/delta x be less than 1 (u sub w is the linear velocity of the aqueous phase); the magnitudes of the mass transfer time constant and the rise velocity of the bubbles did not affect the maximum value of delta t which can be used. The time constant for mass transfer is the reciprocal of the least positive eigenvalue of a suitable chosen diffusion problem. The effects of influent flow rate, number of compartments into which the column is partitioned, bubble boundary layer thickness, and Henry's constant for the volatile solute were examined. Approach of aeration columns to steady-state operation is relatively sluggish, as is their response to concentration-pulse overloads. (Sand-PTT)
W89-10706

USE OF ELECTRODIALYSIS TO REMOVE HEAVY METALS FROM WATER,
Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
K. L. Gering, and J. F. Scamehorn.
Separation Science and Technology SSTEDS, Vol. 23, No. 14/15, p 2231-2267, Nov/Dec 1988. 10 fig, 3 tab, 44 ref. Bureau of Mines grant G1125132-4001.

Descriptors: *Wastewater treatment, *Heavy metals, *Cadmium, *Electrodialysis, Waste recovery, Membranes, Electrolytes.

The removal of heavy metals from water by using electrodialysis is discussed. Parameters studied include current efficiency, stack resistance, and osmotic water transfer. Four single-electrolyte systems are investigated: CdCl2 and CdSO4 are used as representative heavy metal salts; NaCl and CaCl2 are studied in order to enhance the understanding of physical electrodialytic processes in general and to provide a basis of comparison. The variables of electrolyte type, electrolyte concentration, pH, temperature and elapsed time of membrane usage are examined. Results indicate that the purification of Cd-laden waters can be achieved while maintaining high current efficiencies and reasonable stack resistances. The osmotic water transfers (in units of liter/mole) of the above Cd salts are small enough to allow a high percentage of a wastewater stream to be reclaimed as purified water, but are higher than the water transfers of NaCl and CaCl2 due to increased hydration effects. (Author's abstract)
W89-10707

TREATMENT OF LANDFILL LEACHATE BY SPRAY IRRIGATION--AN OVERVIEW OF RESEARCH RESULTS FROM ONTARIO, CANADA: I. SITE HYDROLOGY,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. A. McBride, A. M. Gordon, and P. H. Groenevelt.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 510-517, April 1989. 2 fig, 3 tab, 7 ref. Ontario Ministry of Environment Project 244-RR.

Descriptors: *Water pollution treatment, *Water pollution control, *Ontario, *Groundwater pollution, *Sanitary landfills, *Spray irrigation, *Land application, Geohydrology, Muskoka Lakes, Leachates, Liners, Aquifer management, Wastewater collection, Polymers.

A study was initiated in 1986 to evaluate leachate spray irrigation as a cost-effective, environmentally-sound, and long-term solution to the Muskoka Lakes sanitary landfill seepage problem. The system consists of a collection trench to intercept leachate flow from a contaminated aquifer emanating from the landfill, two settling lagoons providing limited aeration treatment, and a network of 72 spray irrigation nozzles distributing partially treated leachate over three areas totalling approximately 4.3 ha in a mixed hardwood forest. The research effort aimed to find ways of reducing the total volume of leachate being generated and handled at the site and at finding ways to reduce the amount

of groundwater in contact with the landfilled refuse. It was determined that the clay surface liner over the landfill was both discontinuous and thin. The incomplete sealing of the landfill was in part a consequence of the lack of locally available clay soil for liner material. Subsequent tests indicated that an industrial latex polymer-sand mixture would be a suitable substitute liner; the material is available at no cost because it is a commercial byproduct. Investigations of the hydrologic characteristics of the Muskoka Lakes site suggest that large scale groundwater diversion works are not required around the perimeter of the refuse cell but that a more effective collection system should be installed on the downslope side of the landfill. The long-term resolution of the leachate generation problem, however, rests on the achievement of both a suitable reduction in landfill liner infiltration and removal of groundwater in contact with the landfilled refuse through dewatering operations. (Rochester-PTT)
W89-10730

TREATMENT OF LANDFILL LEACHATE BY SPRAY IRRIGATION--AN OVERVIEW OF RESEARCH RESULTS FROM ONTARIO, CANADA: II. SOIL QUALITY FOR LEACHATE DISPOSAL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
R. A. McBride, A. M. Gordon, and P. H. Groenevelt.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 518-525, April 1989. 2 fig, 3 tab, 5 ref. Ontario Ministry of the Environment Project 244-RR.

Descriptors: *Water pollution treatment, *Water pollution control, *Ontario, *Groundwater pollution, *Sanitary landfills, Soil properties, Soil genesis, Muskoka Lakes, Leachates, Hydraulic conductivity, Nutrients, Iron, Potassium, Cations, Forests, Microorganisms.

The Muskoka Lakes (Ontario) sanitary landfill system consists of a collection trench to intercept leachage flow from a contaminated aquifer emanating from the landfill, two settling lagoons providing limited aeration treatment, and a network of 72 spray irrigation nozzles over a spray area of 4.3 ha. The local soils were characterized and their water regimes were determined both in situ and in the laboratory to refine the application rate recommendations for partially treated leachate. Leachate distribution was highly uneven over the three spray areas in 1986. Large loadings of iron-laden leachate appear to accelerate changes over relatively short periods of time that can radically alter soil water and nutrient regime. A mean field-saturated hydraulic conductivity of 0.0075 cm/sec was obtained in the deep, non-irrigated sands near spray area 3. Prolonged spraying has dramatically lowered the attenuation capacity of the Muskoka Lakes soil for K and for most other cations, whereas only Fe attenuation appears to be largely unaltered due to past leachate applications. Given the nature of the local soils, the forest floor litter layer is key to increasing the residence time of the wastewater in the unsaturated zone and effecting a suitable level of renovation before the effluent reaches the groundwater table. High water table levels and shallow bedrock over much of spray areas 1 and 2 greatly reduce this residence time and cause the formation of leachate breakouts in depressional areas. The less than satisfactory wastewater distribution system gives rise to localized application rates far exceeding the evapotranspirational demand and soil attenuation capacity. Pretreatment of leachate for Fe removal is necessary to avert major soil morphological changes with long-term spray irrigation. Major transformations in the soil water regime due to heavy leachate loadings and soil morphological changes are responsible for adverse impact on forest microbial populations and possibly on forest understory communities and tree vigor. Spray irrigation with leachate has induced a relatively rapid forest decline. (Rochester-PTT)
W89-10731

FATE OF ORGANIC CONTAMINANTS DURING SEWAGE SLUDGE COMPOSTING,
Connecticut Agricultural Experiment Station, New Haven. Dept. of Soil and Water.
K. D. Racke, and C. R. Frink.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 526-533, April 1989. 1 fig, 1 tab, 23 ref.

Descriptors: *Wastewater treatment, *Sludge, *Composting, Isotope studies, Isotopic tracers, Hydrocarbons, Aromatic compounds, Pesticides, Carbaryl, Phenanthrene, Temperature, Soil amendments, Path of pollutants, Carbon radioisotopes.

The fate of two representative organic contaminants (radiolabeled), the polyaromatic hydrocarbon phenanthrene and the pesticide carbaryl, during composting of municipal sludge was examined. A benchtop laboratory compost apparatus was used that has been found to accurately simulate Beltsville aerated-pile composting conditions. Laboratory composting experiments resulted in composting periods of from 18-20 days before return to ambient conditions. All composting cycles except one with phenanthrene in which the temperature was limited to 55 C, were characterized by a drop in temperature after 6-9 days, and a brief recovery to thermophilic temperatures before return to ambient temperatures. Between 89-93% of the initially applied phenanthrene persisted unchanged in the finished compost. Very little mineralization of phenanthrene occurred and 14CO2 formation represented < 1% of applied phenanthrene. Quantities of unextractable metabolites remaining in the compost ranged from 14.7-16.9% of applied 14C. Phenanthrene was just as persistent in the compost from the experiment in which temperatures were limited to 55 C. In the case of carbaryl, only 2.6-4.2% of the initially applied 14C could be extracted from the compost at the end of the composting cycle. Between 1.6-4.9% of the applied carbaryl was mineralized to 14CO2 during composting. It appears that some pollutants will persist through the composting process to appear in finished composts that are applied to soil. Thus, it may be important to consider the fate of organic contaminants in compost-amended soils. (Rochester-PTT)
W89-10732

ROLE OF MACROPHYTES IN CYCLING OF HEAVY METALS IN WATER ECOSYSTEMS (ROLAMAKROFITOW W KRAZENIU METALI CIEZKICH W EKOSYSTEMACH WODNYCH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
T. Ozimek.
Wiadomosci Ekologiczne WEKLAF, Vol. 34, No. 1, p 31-44, 1988. 3 fig, 1 tab, 63 ref. English summary.

Descriptors: *Fate of pollutants, *Path of pollutants, *Macrophytes, *Heavy metals, *Biotransformation, *Water pollution treatment, *Bioaccumulation, Absorption, Plant tissues, Environmental control, Ecosystems, Phenology, Seasonal variation, Physiological ecology, Life cycles, Decomposition, Photosynthesis, Biomass, Aquatic habitats.

The role of macrophytes in the cycling of heavy metals and the possibilites of using them to remove these metals from water was studied. Macrophytes absorb and retain considerable amounts of heavy metals in their tissues. The range of heavy metals concentration in macrophytes is broad, even within one species. It depends on a number of environmental factors (concentrations of metals in water and sediments, form of a given metal, interaction among metals, pH, temperature), and on the biology and ecology of a particular species (degree of development, ecological type, phenological phase). Bryophytes adsorb and accumulate much greater amounts of metals than seed plants. The majority of heavy metals are not distributed evenly in particular plant organs and their contents are the greatest in the organ absorbing the metal. Seasonal variability of concentrations of heavy metals in macrophytes depends on the life cycle of a plant, physiological demand, and the character of the element. Heavy metals return from macrophytes to habitat mainly during decomposition of macrophyte tissues when they are excreted or when chemically bound with particles of plant detritus. Aquatic plants excrete small amounts of metals. An excess of heavy metals damages macrophytes, mainly by disturbing the photosynthesis. One of the limitations of using macrophytes for removing heavy metals from waters is that concentrations of heavy metals that are too high in plant tissues negatively affect the photosynthesis and thus the amount of biomass produced (the higher the plant biomass the more metals can be removed from the habitat) and also that too much contamination of the macrophytes with heavy metals limits their further utilization. (Author's abstract)
W89-10803

ACCELERATING ELECTRONS,
D. Morse.
Civil Engineering CEWRA9, Vol. 59, No. 4, p 64-66, April 1989. 1 fig.

Descriptors: *Wastewater treatment, *Irradiation, *Disinfection, *Electron beams, *Electron accelerators, *Degradation, Miami, Cost analysis, Performance evaluation, Construction, Sludge disposal, Technology, Rehabilitation, Chlorination, Water treatment, Bacteria, Viruses, Safety.

The Virginia Key Wastewater Treatment Plant in Miami has the only full-scale electron accelerator in the world located in a treatment plant. For the next two years, scientists will be collecting data to document the accelerator as a cost-effective and reliable option for wastewater treatment. The 1.5 million v 'e-beam' leaves no radiation in the treated water. Operators are protected by 4-ft-thick walls that surround the e-beam room. Early tests have shown the e-beam capable of killing bacteria, protozoa, viruses, worms, and virtually any other organism that lives in wastewater. The e-beam also detoxifies hazardous organic substances, probably by generating oxidizing radicals. Since the 1.5 million v e-beam is too strong for disinfection of water and wastewater, scientists will be determining the exact dosages required to inactivate microorganisms and destroy hazardous chemicals. The operating costs are small; the beam now requires 75 kw (about $4.50 per hour) to operate. The accelerator was constructed from 1981 to 1984 as part of EPA's innovative technology program. (Doria-PTT)
W89-10821

GAS CHROMATOGRAPHIC STUDIES ON THE BIODEGRADATION OF NITROBENZENE AND 2,4-DINITROPHENOL IN THE NITROBENZENE PLANT WASTEWATER,
Institute of Science, Bombay (India). Analytical Lab.
S. S. Patil, and V. M. Shinde.
Environmental Pollution ENPOEK, Vol. 57, No. 3, p 235-250, 1989. 3 fig, 7 tab, 21 ref.

Descriptors: *Gas chromatography, *Biodegradation, *Aromatic compounds, *Wastewater treatment, *Phenols, *Wastewater analysis, Industrial wastewater, Activated sludge, Monitoring, Dye industry wastes, Chemical oxygen demand, Suspended solids, Toxicity, Acclimatization.

The biodegradation of nitrobenzene (NB) and 2,4-dinitrophenol (DNP) in NB plant wastewater has been studied using acclimated activated sludge in a batch bioreactor. The gas chromatographic (GC) monitoring shows simultaneous utilization of these two substrates, and both NB and DNP were ultimately biodegraded. The primary and ultimate biodegradation rates using GC and COD methods, respectively, are compared. The biodegradability observed by GC and COD methods shows primary biodegradation, and ultimate biodegradation, respectively. Although the primary biodegradation of the substrates shows 100% removal, the ultimate biodegradation in terms of COD is in the range of 80-90%. The biodegradation rates show that the NB removal rates are decreased as the NB-DNP exposed activated sludge is further exposed to the wastewater system. However, DNP removal rates are doubled for the wastewater system at about the same substrate loadings. The present investigation leads to the following conclusions. (1) NB and DNP in the NB plant wastewater are biodegrada-

ble. (2) The substrate(s) utilization is complete and simultaneous from the wastewater system. (3) The binarysubstrate (NB and DNP), exposed to aniline plant wastewater acclimated activated sludge, exhibit sequential utilization, but when the sludge was further exposed to NB plant wastewater, the substrates were degraded simultaneously. (4) In a monosubstrate system, the utilization of DNP is affected when the concentration is changed from 30 to 60 mg DNP/l of mixed liquor volume. (Doria-PTT)
W89-10825

REMOVAL OF HEAVY METALS FROM AQUEOUS EFFLUENTS BY IMMOBILISED FUNGAL BIOMASS,
University of Manchester Inst. of Science and Technology (England).
D. Lewis, and R. J. Kiff.
Environmental Technology Letters ETLEDB, Vol. 9, p 991-998, 1988. 5 fig, 1 tab, 14 ref.

Descriptors: *Heavy metals, *Fungi, *Biomass, *Wastewater treatment, *Biological wastewater treatment, Cadmium, Copper, Iron, Manganese, Lead, Zinc, Acidity, Temperature, Cations, Chelating agents, Organic compounds, Hydrochloric acid.

Columns of immobilized fungal biomass appear to be an effective method for removing low levels of a range of metals from aqueous solutions. However, the complex nature of some industrial effluents may greatly reduce the efficiency of the process especially if high levels of calcium and magnesium, strong chelating agents, or other divalent cations are present. In many cases, the use of much larger amounts of biomass or multicolumn systems could overcome these problems. The most critical factor affecting performance is solution pH with optimal metal removal between pH 6 and 9. The decreased affinity of the biomass for metals at low pH can be used as a procedure for column regeneration allowing reuse through a number of cycles. Bearing these points in mind, it is envisaged that this technique could be developed for the treatment of low ionic strength effluents or for the final polishing of pretreated effluents prior to discharge. (Author's abstract)
W89-10838

STUDY ON WASTEWATER TREATMENT BY AEROBIC BIOLOGICAL FLUIDIZED BED (IN KOREAN),
B. H. Lee, and J. M. Lim.
Bulletin of National Fisheries University of Pusan. Vol. 28, No. 1, p 19-26, 1988. 8 fig, 6 tab, 9 ref. English summary.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Fluidized bed process, *Aerobic treatment, Chemical oxygen demand, Biological oxygen demand, Retention time, Bacteria.

The best operating conditions and treatment efficiencies of biological fluidized bed wastewater treatment methods were evaluated. Maximum COD removal efficiencies were obtained at 210-250% bed expansion. When the fluidized bed operated at 0.61 kg BOD/kg mixed liquor volatile suspended solids/day and a hydraulic retention time (HRT) of 2 hrs, the BOD removal efficiency was 90%. Filamentous bacteria were observed at a HRT of 2 hrs and a large quantity of filamentous bacteria accumulated at HRTs of 1 hr because of a lack of oxygen. Aerobic biological fluidized bed Process can be supplied McKinney's mathematical Model for CMAS. (Author's abstract)
W89-10849

PROCEEDINGS OF THE 43RD INDUSTRIAL WASTE CONFERENCE.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan. 1989. 863 p. Edited by John M. Bell.

Descriptors: *Wastewater treatment, *Waste disposal, *Regulations, Conferences, Legal aspects, Landfills, Hazardous wastes, Biological treatment, Sorption, Industrial wastes, Training.

The 43rd Industrial Waste Conference was sponsored by the School of Civil Engineering of Purdue University. Of the ninety-four technical papers presented during the three days of the conference, eighty-nine are compiled into these proceedings. The papers are divided into the following eight major sections: toxic and hazardous wastes; site remediation; landfills; biological systems; sorptive processes; processes and product development; industrial wastes; and laws, regulations, and training. (See W89-10895 thru W89-10939) (Lantz-PTT)
W89-10858

TOXICITY REDUCTION--HAVE THE BUGS HAD IT,
AWARE, Inc., Nashville, TN.
W. W. Eckenfelder.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 1-5, 4 fig, 2 tab, 12 ref.

Descriptors: *Priority pollutants, *Toxic wastes, *Wastewater treatment, *Toxicity, *Biological treatment, Biochemical oxygen demand, Regulations, Organic compounds, Industrial wastewater.

Recent legislation has changed the emphasis of biological wastewater treatment process performance. Consideration must now be given to residual priority pollutants in micrograms/L levels and aquatic toxicity as defined by a bioassay. It becomes obvious that kinetic relationships in terms of biochemical oxygen demand (BOD) are no longer applicable in these cases. Achievable effluent levels of specific priority pollutants in a biological treatment process are a function of the solids retention time, the influent concentration of the pollutant, the characteristics of the wastewater being treated, and temperature. Permits relative to effluent limitations on priority pollutants or aquatic toxicity should be site specific unless water quality criteria dictate a more stringent limitation. Requirements beyond biological waste treatment, while beneficial to the carbon manufacturers, is technically, economically and practically infeasible except in specific cases. The present data base does not support rigid effluent criteria for most priority pollutants. Aquatic toxicity data on specific organics are generally not applicable to industrial wastewater effluents since a majority of these organics are removed in the biological treatment process. (See also W89-10858) (Lantz-PTT)
W89-10859

PAC BIOTREATMENT OF HAZARDOUS COMPOUNDS FROM AN INTEGRATED OIL REFINERY,
Centre for Research in Environmental and Water Resources Engineering, Haifa (Israel).
N. Galil, and M. Rebhun.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 19-28, 10 fig, 4 tab, 25 ref.

Descriptors: *Activated carbon, *Hazardous wastes, *Oil refineries, *Wastewater treatment, *Biological treatment, Industrial wastes, Activated sludge process, Organic compounds, Phenols, Biodegradation.

Problems encountered in activated sludge treatment of wastewater from an integrated oil refinery can be classified into three major categories: (1) slow rate (kinetics) of the bioprocess due to inhibitory effect of phenolic compounds; (2) 'escape' of biomass in effluent ascribed to poor bioflocculation and frequent high hydrocarbon content; and (3) sudden discharges of concentrated phenolic wastes disrupted the process, first by impairing bioflocculation, followed by complete disruption of the biological process. Powdered activated carbon (PAC) addition to activated sludge is suggested in many cases as a modification being able, potentially, to improve the process, especially in the case of concentrated industrial wastewater containing refractory, toxic and hazardous compounds. The purpose of the combined PAC activated sludge treatment process in this study is to adsorb a great part of the phenols by the PAC in order to lower their load on the biomass and reduce the inhibitory action expected at high loadings of phenols, particularly cresols and xylenols. The major objective was to study the effect of PAC on substrate removal rate by the biomass, obtain rate constants, evaluate degree of inhibition and to correlate it with adsorption of the different phenols by PAC. An important part of the organics, 40%, were removed by stripping. Organics unremoved by stripping could be classified into three categories: adsorbed on PAC, most of them phenols; removed by biodegradation; and residual in effluent, most of them nonbiodegradable. The adsorption of hazardous phenolic compounds enables an improvement in the kinetics of biodegradation. No improvement in settling characteristics of mixed liquor suspended solids could be achieved by PAC addition. (See also W89-10858) (Lantz-PTT)
W89-10861

DEVELOPMENT OF A COMPUTERIZED MODEL FOR WASTE REDUCTION ALTERNATIVES,
Illinois State Water Survey Div., Savoy. Hazardous Waste Research and Information Center.
G. D. Miller, D. L. Thomas, C. A. Washburn, F. Brookfield, and D. D. Kraybill.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 29-33, 3 fig, 1 tab.

Descriptors: *Computer models, *Wastewater treatment, *Information exchange, Model studies, Recycling, Water quality control, Waste management, Hazardous materials.

The Hazardous Waste Research and Information Center (HWRIC) was established in 11984 as a part of the State Water Survey Division of the Illinois Department of Energy and Natural Resources (ENR). One of the goals of HWRIC and of many agencies dealing with hazardous waste issues is to help industry find ways to reduce the amount and toxicity of hazardous wastes generated. Through contacts with industry it became clear in 1986 that there is a great need for technical assistance and organized information on waste reduction. There was no publicly available organized body of literature on waste reduction. In addition, case studies or examples of waste reduction successes were often either not published or available only in specialized, limited distribution reports. A computerized information base and advisory system was thought to be needed that could be used for technical assistance and made available to industry. As a result, HWRIC joined several other states in the National Roundtable of State Water Reduction Programs to cooperatively develop the Multi-Option Model (MOM) which is an interactive computerized waste management tool. The primary purpose of the MOM is to increase a generator's knowledge of the wide range of options for reducing, recycling, and treating industrial waste. In particular, the MOM is expected to promote waste reduction at the source and recycling. A secondary purpose of the MOM is to provide guidance for technical assistance and facility planning. The MOM is primarily designed to be used by industrial engineers and plant managers with the help of a technical assistant. The first step is to characterize the generator's waste types and amounts. The program then offers three options for providing the generator with information: the Waste Reduction Advisory System (WRAS); the Waste Exchange; and the Treatment, Storage, and Disposal (TSD) Advisory System. Primary developmental emphasis is on the WRAS, since source reduction is the number one choice for waste management. (See also W89-10858) (Lantz-PTT)
W89-10862

RESPIROMETRIC METHOD FOR BIOKINETIC CHARACTERIZATION OF TOXIC WASTES,
Delaware Univ., Newark. Dept. of Chemistry.

A. F. Gaudy, A. Ekambaram, and A. F. Rozich.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 35-44, 6 fig, 5 tab, 13 ref.

Descriptors: *Toxic wastes, *Wastewater treatment, *Respirometry, *Biokinetics, Mathematical studies, Hazardous wastes, Biomass, Oxygen, Growth kinetics, Growth rates.

Recent papers have described the use of kinetic models and parameters computed from the biokinetic constants included in them to predict performance of activated sludge processes treating either noninhibitory or toxic organic substrates. The major impediment to more general use of kinetic models in plant operations has been the need for periodic evaluation of the biokinetic constants and the realization that the procedures for obtaining numerical values of these constants is somewhat laborious. Previous studies have shown that the accumulated oxygen uptake curve could be used to compute the growth curves from which values of the specific growth rate (u) at various concentrations of substrate, S sub o, could be determined. The approach, under conditions wherein measurement of growth was by the usual method, i.e., optical density, was difficult and the 'O2 surrogate' technique, as it was called, saved much labor and time in amassing the required data. Results show that the O2 surrogate technique adequately measures the course of biomass growth by measuring respiration, i.e., accumulated O2 uptake, for systems growing at slow specific growth rates such as those encountered with a toxic or inhibitory carbon source. The method had previously been shown to be applicable to more rapidly growing systems using a non-toxic carbon source. The method offers much opportunity to save labor in performing growth studies and the technique can be used on waste systems not readily amenable to direct measurement of growth. In general, the three methods of analyzing data to obtain numerical values of the three biokinetic constants, u sub max (maximum specific growth rate), K sub s (substrate concentration at which u=u sub max/2), and K sub i (inhibition constant used in the Haldane equation for growth on inhibitory substrates), were shown to yield essentially the same values. The results also show that the O2 surrogate procedure and the subsequent use of the technique for estimating the values of the biokinetic constants yield values of u which adequately predict the wash-out behavior of a continuous growth reactor system. (See also W89-10858) (Lantz-PTT)
W89-10863

INNOVATIVE PROCESS FOR TREATMENT OF SULFURIC ACID WASTE LIQUIDS WITH RECOVERY OF ANHYDROUS SODIUM SULFATE,
Canviro Consultants Ltd., Mississauga (Ontario).
B. Asano, and I. M. Olper.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 45-50, 4 fig, 4 tab, 4 ref.

Descriptors: *Wastewater treatment, *Sulfuric acid, *Sodium sulfate, *Waste recovery, Sodium carbonate, Chemical treatment, Lead, Economic aspects, Industrial wastes, Ontario.

Tonolli Canada Ltd. is a lead recovery and refinery plant located in the City of Mississauga, Ontario, Canada. Approximately 80% of the feedstock for the plant comes from batteries purchased from scrap dealers and battery manufacturers within 600 km of Mississauga. Electrolyte drained from the batteries is 17 weight sulfuric acid. This operation generates approximately 9 million L/yr of sulfuric acid liquids. In 1985, Tonolli was requested by the Regional Municipality of Peel to investigate options available for acid recycling or waste treatment to reduce the concentration of soluble sulfate in the discharge to the sewer from the plant. After evaluating a number of options in detail, including lime neutralization, caustic neutralization, waste acid upgrading, and the sale of waste acid without treatment, Tonolli selected the CX Process to satisfy the Region's new waste management request. The process, which has been proven in two commercial facilities in Europe, is based on neutralization and reaction of the acid waste with sodium carbonate followed by evaporative crystallization. In addition to overcoming the liquid waste disposal problem, the process has the benefit of recovering detergent-grade sodium sulfate as a byproduct for sale. The process also dramatically reduces the volume of solid waste (slag) that is normally generated in the lead recovery operation. Thus the process has the double benefit of byproduct recovery and waste minimization. (See also W89-10858) (Lantz-PTT)
W89-10864

DETERMINATION OF TOXICITY THRESHOLDS OF INDUSTRIAL WASTESTREAMS TO ACTIVATED SLUDGE PROCESS USING FED BATCH REACTOR,
Donohue and Associates, Inc., Milwaukee, WI.
J. Patoczka, G. W. Pulliam, and G. L. Chowning.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 51-59, 14 fig, 16 ref.

Descriptors: *Toxicity, *Industrial wastewater, *Wastewater treatment, *Toxic wastes, *Activated sludge process, Batch treatment, Biological treatment.

The fed batch reactor (FBR) procedure for assessing toxicity to biological treatment is one of the methods employing measurement of substrate removal. In this study, a fed batch reactor procedure was investigated as a method to determine toxicity of industrial discharges and individual chemicals to activated sludge process. The method is based on continuous addition of a high strength feed containing a potential toxicant to a batch activated sludge reactor for a period of two to three hours. In this way, sludge response can be obtained over a large toxicant concentration range in a single test. The FBR test was found to be a simple and inexpensive test for rapid screening of wastestreams for acute inhibition/toxicity to activated sludge. Under favorable conditions, a threshold concentration (or rate of discharge) can be established. Disadvantages of the FBR test include some drawbacks inherent to all batch-type tests including, lack of definition of chronic effects. Furthermore, biological sludge used in the FBR test does not have the benefit of acclimation to the tested wastestream. Interpretation of the substrate removal rates may also be complicated by substrate biosorption, i.e., rapid initial substrate uptake onto the biological floc sorptive mechanisms. Some sludges, particularly in combination with simple, carbohydrate-based substrates, exhibit biosorption. In an FBR test, following the rapid initial substrate uptake, a decrease in the apparent removal rate occurs as manifested by an upward deflection of the substrate build-up curve. This can be mistaken for inhibition. (See also W89-10858) (Lantz-PTT)
W89-10865

USE OF A BATCH ASPHALT PLANT FOR REMEDIATION OF SOILS CONTAMINATED BY VOLATILE ORGANIC COMPOUNDS,
Donohue and Associates, Inc., Milwaukee, WI.
L. C. Trick, M. A. Kuehl, and R. M. Uschan.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 61-65, 4 tab.

Descriptors: *Cleanup operations, *Soil contamination, *Volatile organic compounds, *Wastewater treatment, Organic compounds, Industrial wastes, Excavation, Batch treatment, Volatilization, Soil treatment.

In 1980, volatile organic compounds (VOCs) were found at trace concentrations in the well water supply of the City of New Brighton, Minnesota. A consultant under contract to the US EPA examined local industrial operations and listed potential sources of VOC in the drinking water. The primary suspected source was the Twin City Army Ammunition Plant (TCAAP); however, several other potential sources outside the boundaries of TCAAP were identified. One site selected for further investigation is an area approximately one mile southwest of TCAAP and one-half mile northeast of the City of New Brighton. The property was previously owned by the Minnesota Transfer Railway Company (MTR) which in recent history leased portions to various light industrial and commercial enterprises. One lessee was the Trio Solvents Company, a recycler of waste solvents. The site, generally known as the Trio Solvents (Trio) area, is listed on the National Priorities List. During the investigation, the consultant found an area of soil impacted by organic solvents. The affected area was approximately 150 ft northwest of the building formerly used for painting operations. The impacted area covered about 7,700 sq ft. The predominant organic solvents in these soils were trichloroethylene (TCE) and xylenes. No other areas of solvent impacted soils were found in the study area. In February 1986, the remedial investigation contractor submitted a report to MRT addressing options for clean-up of impacted site soils. The options included: (1) treatment of excavated soil in a screw-conveyer roaster; (2) treatment of excavated soil in a soil-scrubber; (3) landfill of excavated soil; (4) landfarming of excavated soil to evaporate solvents; (5) landfarming of excavated soil employing advanced microbiological action; (6) soil venting; (7) in-situ microbiological decontamination; and (8) excavation and treatment in batch asphalt plant. MTR selected the response action that included excavation of impacted soils to a depth of approximately 12 ft followed by heating of soils in an adjacent batch asphalt plant to volatilize the solvents. Approximately 400 lbs of solvent were removed from the site soils, and approximately 40 lbs of solvent remain in the soil and groundwater below the excavation. (See also W89-10858) (Lantz-PTT)
W89-10866

REMOVAL AND TREATMENT OF DISSOLVED AND FLOATING ORGANIC COMPOUNDS IN A CONTAMINATED GROUNDWATER,
EDI Engineering and Science, Grand Rapid, MI.
For primary bibliographic entry see Field 5G.
W89-10870

FIRST 'SITE' FIELD EVALUATION,
HAZCON, Inc., Brookshire, TX.
For primary bibliographic entry see Field 5G.
W89-10871

VOLATILIZATION OF PERCHLOROETHYLENE FROM STAGNANT WATER AND SOIL,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-10872

PREPARING A REMEDIAL DESIGN FOR CLEANUP OF THE NEW LYME SUPERFUND SITE,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5G.
W89-10873

PRELIMINARY ASSESSMENT OF A MICROFILTRATION/REVERSE OSMOSIS PROCESS FOR THE TREATMENT OF LANDFILL LEACHATE,
Zenon Environmental, Inc., Burlington (Ontario).
T. A. Krug, and S. McDougall.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 185-193, 6 fig, 4 tab, 4 ref.

Descriptors: *Landfills, *Leachates, *Reverse osmosis, *Microfiltration, *Wastewater treatment, *Water pollution treatment, Chemical treatment, Hazardous materials.

Toxic and hazardous compounds can originate from landfill leachates as a result of the soluble components of solid and liquid wastes being

leached into surface water and groundwater. At some landfill sites, leachate which is collected is discharged to municipal sewers for treatment in conventional sewage treatment processes. At other landfill sites where sewer lines are not available, the leachate water may be hauled off-site for treatment, may be recycled back to the landfill site, or may be discharged to a surface water source. Cross flow filtration processes including microfiltration (MF), ultrafiltration (UF) and reverse osmosis (RO) have been applied to the treatment of a wide variety of industrial wastewater streams. This study involves the assessment of a two stage process for the treatment of landfill leachates involving precipitation and microfiltration for removal of toxic metals and suspended solids and concentration of residual organics by reverse osmosis. The first step precipitation/microfiltration provides a simple pretreatment process prior to RO. The solids generated in this first stage of the process can be dewatered in a plate and frame or similar filter press and solidified prior to final disposal. The treated water is free of suspended solids which if present would cause problems in the operation of the RO system. The first stage precipitation/microfiltration step was capable of removing suspended solids, metals and hardness from the raw leachate. These contaminants will interfere with the operation of RO systems downstream in the process and can reduce the rate of biodegradation of organics in the leachate. The process is resistant to upset and provides a consistent high quality product water required for RO processing. The RO process has been shown to be capable of concentrating virtually all the remaining organics and dissolved solids present from the first stage of treatment and generating a clean product water with very low levels of any problematic contaminants. The process of precipitation/microfiltration can be used for removal of suspended solids, metals and other contaminants in a variety of wastewater applications. (See also W89-10858) (Lantz-PTT)
W89-10882

COMPARISON OF GLUCOSE AND METHANOL AS CARBON SOURCES FOR DENITRIFICATION IN BIOLOGICAL TREATMENT OF LEACHATE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
R. Manoharan, S. Liptak, P. Parkinson, D. Mavinic, and C. W. Randall.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 195-202, 8 fig, 1 tab, 9 ref.

Descriptors: *Denitrification, *Landfills, *Wastewater treatment, *Biological treatment, *Leachates, Glucose, Methanol, Ammonia, Carbon, Methanol.

Leachates from 'older' landfills are high in ammonia and low in carbon. These leachate discharges affect the receiving water bodies by providing nutrients for eutrophication, by exerting an oxygen demand through the nitrification of ammonia, and because of ammonia toxicity. The biological nitrification-denitrification process is one of the most promising methods available for removing ammonia from older landfill leachates. A single sludge nitrification-denitrification process is capable of removing large concentrations of ammonia from landfill leachates. The external carbon source, which may be needed for denitrification (due to low biodegradable carbon content in the older ieachates) should be carefully chosen to avoid problems with the process. Glucose, as the external carbon source, produced unreliable nitrification and denitrification performances. It was believed to have provided a competitive environment for facultative anaerobes, at the expense of denitrifiers. Due to unreliable nitrification performance a desirable carbon to nitrate-produced ratio could not be maintained for proper denitrification. Methanol, as the external carbon source, did not produce any problems with the process. Excellent nitrification and denitrification performances were obtained, resulting in complete ammonia removal by the system throughout the duration of the study. (See also W89-10858) (Lantz-PTT)
W89-10883

DEGRADATION OF ACETONITRILE BY PSEUDOMONAS AERUGINOSA,
Selma Univ., AL. Div. of Natural and Applied Sciences.
For primary bibliographic entry see Field 5G.
W89-10886

KINETICS-DYNAMICS OF BIODEGRADATION OF POTENTIALLY TOXIC ORGANIC CHEMICALS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
W. J. Maier.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 257-265, 10 fig, 3 tab, 15 ref.

Descriptors: *Biodegradation, *Growth kinetics, *Organic compounds, *Wastewater treatment, Microbial degradation, Microbiological studies, Batch treatment, Mathematical studies.

Review of the literature shows that there is a great diversity in metabolic responses of microorganisms to mixtures of organic chemicals where both substrates can serve as carbon and energy sources but are also potentially toxic. Results from batch reactor tests have been analyzed using additive growth rate functions that incorporate substrate inhibition effects (Haldane model) and substrate interaction effects. The latter is accounted for by adding a substrate interaction term in the denominator of the Haldane modification of the Monod growth rate equations. Interaction functions have been determined for mixtures of chloroorganic substrates and conventional metabolites and for chloroorganics and chemical analogs. Interactions ranging from sequential (diauxic) utilization to concurrent utilization have been characterized using this correlation approach. The effects of different ratios of substrate concentration was found to be important and is accounted for by the substrate interaction terms. The implications of multiple substrate feed solutions have been analyzed for batch and continuous flow reactors. Concurrent utilization usually results in more rapid removal of target substrate because more cell mass is formed even though the rate of target substrate utilization per cell may be slower. However, at very high alternate substrate concentrations, target substrate utilization may be displaced completely and approach diauxic behavior. Practical implications of substrate interaction effects on process performance of continuous flow stirred tank reactors (no recycle) have been analyzed. Operating diagrams of steady-state operations show that concurrent substrate utilization results in enhanced removal of target substrate. Process stability is also enhanced and allows operating at shorter residence time if the growth rate coefficient of the alternate substrate is higher than that of the target substrate. Model calculations of pulsed additions of alternate substrates have been described. A computer program that solves the differential mass balance equations by numerical integration was used to simulate time dependent effluent concentrations of both substrates and cell mass. This type of analysis allows defining appropriate ranges of mixed substrate addition. Beneficial effects of adding alternate substrates in order to enhance removal of a targeted substrate is potentially interesting for optimizing removal of trace chemicals in wastewater treatment plants. (See also W89-10858) (Lantz-PTT)
W89-10887

PRINCIPLES OF ORGANISM SELECTION FOR THE DEGRADATION OF GLYPHOSATE IN A SEQUENCING BATCH REACTOR,
Notre Dame Univ., IN. Center for Bioengineering and Pollution Control.
D. V. S. Murthy, R. L. Irvine, and L. E. Hallas.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 267-274, 9 fig, 3 tab, 12 ref.

Descriptors: *Biodegradation, *Glyphosate, *Wastewater treatment, Biological treatment, Batch treatment, Ammonia, Nitrification, Denitrification.

Glyphosate removal in a mixed culture--mixed substrate environment is effected by the activity of nitrifiers, denitrifiers and the ammonifiers. Operating strategies that enrich for the nitrifiers and denitrifiers, also enrich for glyphosate degrading activity (GDA). At very high substrate loadings, GDA is repressed by nonglyphosate chemical oxygen demand (COD) and inhibited by excess ammonia production. Addition of ammonia to the feed increase the relative fraction of nitrifiers in the biomass. The nitrifiers improve system performance from two perspectives. First, ammonia produced by ammonifiers during high loading is maintained below inhibitory levels. Second, glyphosate is utilized by the nitrifiers, extending the rate of glyphosate removal beyond what would be expected from the heterotrophs alone. However, proper use of the reactor filling strategies, and suitable manipulation of the process conditions, can eliminate the lag phase associated with the repression of glyphosate degradation by non-glyphosate COD. (See also W89-10858) (Lantz-PTT)
W89-10888

REMOVAL OF ORGANIC COMPOUNDS BY MICROBIAL BIOMASS,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
A. Selvakumar, and H. N. Hsieh.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 275-281, 2 fig, 6 tab, 11 ref.

Descriptors: *Wastewater treatment, *Biomass, *Organic compounds, Microbial degradation, Mathematical studies, Microbiological studies, Activated sludge, Organic carbon, Adsorption.

The fate of hazardous organic pollutants discharged into conventional biological wastewater treatment process is not well understood. These compounds may be removed from the wastewater stream by biodegradation, volatilization (air stripping), sorption by the biomass, precipitation, hydrolysis, etc. Recent studies have shown that the microbial cells (microbial biomass) tend to concentrate chemicals from their aquatic environment. The adsorption process of liquid organic compounds by inactive microbial biomass can be expressed by the Freundlich adsorption isotherm. The extent of biosorption by the microorganisms depends on the type of biomass. A comparison of relative adsorption capacities with the organic carbon content showed a trend. Activated sludge biomass showed the high uptake capacity and also had the larger organic carbon content. Desorption studies show that the desorption is small for compounds with high adsorptive capacity. Octanol/water partition coefficient is a better predictor of the extent of adsorption on biomass than aqueous solubility. The adsorptive capacity of biomass is less compared to activated carbon. However, the uptake per unit surface area is greater for the biomass than for activated carbon. (See also W89-10858) (Lantz-PTT)
W89-10889

BIOLOGICAL TREATMENT OF CHLORINATED PHENOLS USING A ROTATING BIOLOGICAL CONTACTOR,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
R. Y. Tokuz.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 283-289, 5 fig, 5 tab, 12 ref. NSF Grant ECE-8512733.

Descriptors: *Wastewater treatment, *Phenols, *Biological treatment, Chlorophenol, Dichlorophenol, Trichlorophenols, Pentachlorophenol, Organic compounds.

This study examined the treatability of four chlorinated phenols (2-chlorophenol; 2,4-dichlorophenol; 2,4,6-trichlorophenol; and pentachlorophenol) using a pilot scale rotating biological contactor (RBC) unit. A 4-stage, pilot scale rotating

biological contactor unit was used in this study. The discs of the unit are 0.5 m in diameter and made of high density polyethylene. The hydraulic loading of the system was maintained at 1.5 gallons/sq ft/day which is equivalent to a hydraulic retention time of 2.3 hours. The organic loading was 6.0 lb COD/1000 sq ft of the disc surface area/day. A synthetic wastewater was used. Daily analyses for the following parameters were performed: influent COD, filtered effluent COD, influent and effluent chlorinated phenols concentrations, effluent suspended solids, and pH. Based upon the results of these analyses, it is concluded that RBC is a viable biological treatment process for chlorinated phenols containing wastes. It is likely that by varying the process operational parameters, for example hydraulic retention time-even higher efficiencies may be obtained. (See also W89-10858) (Lantz-PTT)
W89-10890

REMOVAL OF PHENOL IN MIXED SUBSTRATE FORM BY A FIXED FILM PROCESS,
Southern Illinois Univ. at Carbondale. Dept. of Civil Engineering and Mechanics.
S. Faghani-Shoja, B. A. DeVantier, B. T. Ray, and E. E. Cook.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 291-299, 9 fig, 1 tab, 10 ref.

Descriptors: *Biological treatment, *Phenol, *Wastewater treatment, *Fixed film, Chemical oxygen demand, Organic compounds.

Fixed film growth has not been the primary choice for biological treatment of phenol bearing waste. The process does, however, have the ability to handle moderate shock loads, and is relatively simple to operate in practice. In a laboratory study setting a fixed film growth process allows resolution of substrate removal locally, and therefore inhibition can be examined in the context of a spatially varying concentration. The system described in this study is a bench scale fixed film process fed with a synthetic waste composed of varying amounts of pure phenol and a simple sugar. The process is evaluated with regard to its ability to remove phenol at higher concentrations and with different levels of non-inhibitory substrate (sugar). Determination of local concentration levels at which inhibition is detected, is also presented. Stable growth and removal above 90% is demonstrated for feed concentrations up to as high as 500 mg chemical oxygen demand/L (210 mg/L as phenol). Based on these results, it appears that significantly higher concentration phenol feeds can successfully be treated using fixed film processes. The primary benefit observed with the use of mixed inhibitory/non-inhibitory substrate is in mitigation of the negative effects on growth during phenol acclimation. Local inhibition of substrate removal is observed at phenol concentations as low as 50 mg/L. For the phenol feed levels used in this study, no local inhibition was observed beyond the first 40% of reactor length, further indication that higher phenol feed concentrations could readily be treated. (Lantz-PTT)
W89-10891

ADAPTATION AND DEADAPTATION KINETICS OF ACTIVATED SLUDGE,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. Senthilnathan, and J. J. Ganczarczyk.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 301-307, 6 fig, 2 tab, 20 ref, append.

Descriptors: *Wastewater treatment, *Microbial degradation, *Activated sludge, Biological treatment, Phenols, Chemical oxygen demand, Suspended solids, Biomass.

The microbial populations in activated sludge are versatile in degrading various organic priority pollutants, if adequate time for acclimation (adaptation) is given. The rate of biodegradation can drastically vary with the extent of adaptation. However, in a new environment, when the favored substrates are not available, the adapted cultures may lose their ability (deadaptation) to degrade the specific chemicals to which they were adapted. The concept of microbial deadaptation has been used to explain some phenomena associated with the performance of adapted and non-adapted microorganisms. The municipal activated sludge used as a seed in this study did not degrade phenol, but this ability was induced and enhanced to a level of 450 mg chemical oxygen demand/g mixed liquor volatile suspended solids (MLVSS)/hr by a long-term adaptation. Phenol adapted organisms did not lose their ability to utilize phenol during two days of deadaptation by a complete change of the metabolic substrate. However, after ten days of deadaptation, the phenol removal rate decreased by 80%. However, the remaining potential to degrade phenol was well within the values reported in literature for phenol adapted sludge, and obviously much higher than that of the original municipal activated sludge. Activated sludge from municipal sewage treatment plants showed an ability to biodegrade glucose. This ability was not lost by a long exposure to phenol as the only metabolic substrate. Readaptation to glucose was achieved within two days. Specific substrate removal rate increased by 50% in one day and 300% in two days to reach a value of 280 mg glucose/g MLVSS/hr. The process of deadaptation of the adapted biomass may influence biodegradability of organic pollutants which are discharged intermittently. It may also decrease the effectiveness of the bioaugmentation products. (See also W89-10858) (Lantz-PTT)
W89-10892

HEAVY METAL INHIBITION OF RESTING NITRIFYING BACTERIA,
Purdue Univ., Lafayette, IN. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5C.
W89-10893

INFLUENCE OF OPERATIONAL CONDITIONS ON THE VARIABILITY OF ACTIVATED SLUDGE SETTLING CHARACTERISTICS AT FUNCTIONING TREATMENT PLANTS,
Vermont Univ., Burlington. Dept. of Civil and Mechanical Engineering.
J. W. Morris, H. G. Tozer, and L. A. Batchelder Adams.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 313-325, 9 fig, 7 tab, 39 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Fluctuations, Sedimentation, Settling rates, Gravity, Mathematical studies.

The settleability of activated sludge solids are a central consideration in treatment system clarifier design and operations. Empirical settling tests, such as the sludge volume index (SVI), have long formed the basis of judgment in operational management; however, research has indicated that this empirically-based approach can lead to system failure. An alternative management method known as the mass-flux state-point approach has been developed by numerous researchers. It combines a system mass balance with the settling characteristics of the sludge to create a rational design and management tool. The technique permits an activated sludge management system to be mathematically modeled. Factors influencing settling characteristics have been examined by numerous researchers at the labotatory scale. These include: mixing, anoxia, substrate gradients, loading as measured by food/microorganism ratio (F:M), and mean cell residence time. Gravity flux was found to vary significantly over relatively short time intervals. To follow these changes, flux determinations twice weekly during steady operation and daily when conditions are fluctuating, were recommended. Settling characteristics and flux parameters can, and often did, vary independently. Design and operating decisions must consider changes in operational conditions (state point movement) as well as those in solids settleability (gravity flux) to fully assess system potential. The maximum optimum recycle rates at the seven plants ranged from 1.5 to 25.0 times the minimum rate. If mean recycle rates are assumed a typical design point these systems would require recycle flexibility in excess of standard design recommendations at four of the seven plants studied. (Lantz-PTT)
W89-10894

IMPROVED ANAEROBIC DIGESTION WITH LOW LEVEL CHEMICAL PRETREATMENT,
Massachusetts Univ., Amherst.
R. V. Rajan, J.-G. Lin, and B. T. Ray.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 327-337, 8 fig, 3 tab, 16 ref.

Descriptors: *Pretreatment of wastewater, *Wastewater treatment, *Anaerobic digestion, *Chemical treatment, Hydrolysis, Alkalinity, Sodium, Sodium hydroxide, Lime.

Sludge handling costs represent 30 to 40% of the capital cost and about 50% of the operating costs of a typical wastewater treatment facility. About two thirds of the volume of sludge in secondary treatment plants is waste activated sludge (WAS). WAS has to be stabilized sufficiently to reduce its organic content, odor problems and pathogen contamination, before its ultimate disposal. In this study, a relatively simple, less expensive WAS pretreatment process was evaluated for its influence on particulate hydrolysis and the performance of anaerobic digesters. It was the intent of the first phase of this project to study the kinetics of alkaline hydrolysis and to determine the parameters that control the process. Alkaline hydrolysis of waste activated sludge at low temperatures was found to solubilize over 45% of the particulate chemical oxygen demand (PCOD). There are two distinct phases of the hydrolysis reaction; a rapid initial phase followed by a slower second phase that is first order with respect to PCOD. Increasing feed sludge concentration significantly improved hydrolysis at the same alkali level, but increasing temperature from 20 C to 38 C does not improve ultimate hydrolysis at higher alkali levels. At low alkali levels, sufficient drop in pH is achieved and this will eliminate the need for expensive chemical neutralization. Also, at a low alkali level of 4 g NaOH/100 g total solids and feed solids of 4% total solids, the sodium ion concentration will be 0.04 M, which is much less than the threshold toxicity level of 0.3 M. NaOH pretreatment resulted in better particulate hydrolysis than lime pretreatment with Ca(OH)2. Both NaOH and Ca(OH)2 pretreatment improve anaerobic digestion, but NaOH gives better performance. Alkaline hydrolysis can provide a viable alternative to other processes for the pretreatment of WAS prior to anaerobic digestion. (See also W89-10858) (Lantz-PTT)
W89-10895

LOW TEMPERATURE KINETICS OF ANAEROBIC FIXED FILM REACTORS,
Stover and Associates, Stillwater, OK.
E. L. Stover, and R. Gonzalez.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 339-352, 8 fig, 8 tab, 7 ref.

Descriptors: *Wastewater treatment, *Waste treatment, *Growth kinetics, *Anaerobic digestion, *Temperature, Biological treatment, Methane, Microbial treatment, Industrial wastewater, Substrates.

The key to maintaining process control and stable operations in anaerobic biological treatment systems is to provide proper environmental conditions to the biomass or bacteria in the system. Accurate prediction and modeling of both treatment performance and methane production has been accomplished when substrate utilization and methane production were expressed as functions of the mass substrate loading rate (F/M) by monomolecular

kinetics for both suspended growth and fixed-film systems. Substrate utilization, total gas production, and methane production characteristics were all defined during low temperature (25 C) studies with anaerobic fixed-film reactors treating high strength industrial wastewaters. Substrate utilization, total gas production, and methane production were all found to be a function of the mass substrate loading rate with the reactions described by monomolecular kinetics. As the substrate loading rate increased, the substrate removal rates decreased. The low temperature kinetics were compared to the reaction kinetics at higher temperatures of 36 C. The substrate removal kinetics at 25 C were an order of magnitude lower than the kinetics at 36 C due to the low rate of methane conversion. The system was able to successfully treat the wastewater at 25 C; however, at significantly lower substrate loading rates when compared to 36 C operations. The total gas and methane production kinetics at 25 C were also significantly lower than the kinetics at 36 C operations. Low temperature shock load conditions caused a decrease in both gas production and substrate removal; however, the system performance was restored to the original levels when the temperature was increased back to the original level. Low reactor temperatures during the dormant periods of up to two weeks without feeding showed no negative impacts when continuous feeding was restarted. (See also W89-10858) (Lantz-PTT)
W89-10896

DETERMINATION OF ACETOCLASTIC METHANOGENIC ACTIVITY IN ANAEROBIC SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
C. F. Chiang, and R. R. Dague.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 353-362, 10 fig, 2 tab, 18 ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, Acetoclastic methanogenic activity, Microbiological studies, Suspended solids, Volatile solids, Methane.

In recent years, a variety of high-rate anaerobic processes have become popular applications in industrial wastewater treatment. Among these are submerged media anaerobic reactors (SMARs) making use of various feed and flow regimes, including upflow, downflow, and expanded bed, and the upflow, anaerobic sludge-blanket (UASB) approach. All of these anaerobic processes treat wastewaters at a high rate, as compared with traditional anaerobic digesters treating organic sludges. Efficient treatment is achieved by maintaining a long solids retention time (SRT). The spatial distribution biomass and substrate within these processes also varies considerably. It is important to recognize that the active biomass in a reactor is the critical factor in achieving efficient wastewater treatment. A testing protocol is presented for determining acetoclastic methanogenic activity (AMA) using a serum bottle technique. The procedure that is presented is simple, yet consistent, and can be used for routine monitoring of anaerobic systems. Biomass obtained from various heights of three static-bed SMARs was used to evaluate the test procedure. A reproducibility study with four repetitions gives the AMA test a variation coefficient of 6.5% at a mean AMA of 0.39 L CH4 (STP)/gm volatile suspended solids (VSS)/day. The acetoclastic methanogenic activity test developed is a sensitive index to loading changes. The AMA varies widely from 0.05 to 0.72 L CH4 (STP)/gm VSS/day for the SMAR system used in this study. For VSS concentrations < 1 g/L, a higher AMA is associated with lower VSS concentrations. For VSS concentrations > 1 g/L, AMA varies within a narrow range of 0.1 to 0.2 L CH4 (STP)/gm VSS/day. Based on total COD removal and methane production, the steady-state performance of the three SMARs having the same volume but widely different heights was nearly identical. The maximum (saturation) loading for all three reactors appeared to be about 9 gm COD/L/d. (See also W89-10858) (Lantz-PTT)
W89-10897

RESPONSE OF A BUTYRATE-FED ANAEROBIC FLUIDIZED BED REACTOR TO TRANSIENT LOADINGS,
Washington Univ., Seattle. Dept. of Civil Engineering.
F. Labib, J. F. Ferguson, and M. M. Benjamin.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 363-370, 13 fig, 1 tab, 4 ref. NSF Grant ECE-841650.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Microbiological studies, *Fluidized beds, Butyrates, Methane, Chemical reactions, Acetates, Model studies, Kinetics, Oxidation, Organic acids.

Efficient anaerobic treatment requires effective removal of substrate at each stage. Often when a reactor is overloaded or experiences a shock load, the waste conversion efficiency drops. This is marked by accumulation of short-chain-organic acids, mainly acetic, propionic, and butyric. Butyrate is a major intermediate compound in anaerobic processes. Its conversion to CH4 is carried out by acetogenesis followed by methanogensis. The oxidation of butyrate requires a very low H2 partial pressure, and the microbial group that carry out this oxidation are obligately coupled to H2-utilizing bacteria. Butyrate fed fluidized bed reactors were found to consistently remove > 90% of the applied chemical oxygen demand (COD) at specific loading rates of 8 to 10 gm COD/gm bact/d. H2-utilizing methanogen have a large capacity to form methane about tenfold greater than the steady-state rate. Oxidation of butyrate was sensitive to increases in concentrations of H2 and acetate. The butyrate degrading population can be described by a model that incorporates 3 interacting microbial populations. The use of a kinetic expression analogous to that for a reversible, enzyme catalyzed reaction, incorporating the inhibition caused by the presence of the reaction products and the displacement from thermodynamic equilibrium, is appropriate for the oxidation of butyrate in the anaerobic process. Under the conditions tested, inhibition of butyrate oxidation by H2 and acetate was predominant and not apparently due to the reduction in thermodynamic driving force, as it is calculated from the concentrations of reactants and products in the reactor. (See also W89-10858) (Lantz-PTT)
W89-10898

PROPYLENE DICHLORIDE (PDC) REMOVAL FROM WASTEWATER WITH AMBERLITE XAD-4,
Rohm and Haas Co., Philadelphia, PA.
J. M. Ragosta.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 371-374, 5 fig, 2 ref.

Descriptors: *Propylene dichloride, *Wastewater treatment, *Adsorption, Resins, Ion exchange, Methanol, Organic compounds, Polymers.

Amberlite XAD-4 is one of a series of polymeric adsorbents developed for the removal of organics from wastewater. Amberlite XAD-4 is a hydrophobic styrene-divinylbenzene copolymer with especially high affinity for non-polar organics and organic compounds with aromatic rings. The surface area is 800 sq m/g and average porosity is 45 mL of pores/mL of resin. The average pore diameter of 50-75 angstroms is in the optimum range to achieve high adsorption capacity for small organic molecules. Initial laboratory tests were run to determine the effectiveness of removing propylene dichloride (PDC) from the wastewater stream. Several parameters were studied in the pilot study. The optimum regeneration conditions had to be determined because Amberlite XAD-4 can be regenerated either by steam or solvent, or, in some cases, by an aqueous caustic or acid solution. In this case, the effect of steam and methanol regeneration were considered. The capacity of Amberlite XAD-4 for PDC was studied under several sets of conditions. Finally, regeneration efficiency was established. The data demonstrated that Amberlite XAD-4 effectively removes propylene dichloride from wastewater. Methanol regeneration of the adsorbent is a very efficient process and the quantity of regenerant which must be incinerated is minimized. This process removes > 98% of PDC from a 2,200 mg/L stream in a single pass and could be expected to perform even better in a two bed system. (See also W89-10858) (Lantz-PTT)
W89-10899

ADSORPTIVE REMOVAL OF TRACE ELEMENTS FROM COAL FLY-ASH WASTEWATERS ONTO IRON OXYHYDROXIDE,
Montgomery (James M.), Inc., Walnut Creek, CA.
A. R. Appleton, C. Papelis, and J. O. Leckie.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 375-387, 17 fig, 1 tab, 18 ref.

Descriptors: *Wastewater treatment, *Trace elements, *Fly ash, *Iron oxyhydroxide, *Adsorption, Hydrogen ion concentration, Chemical treatment, Arsenic, Selenium, Trace metals, Vanadium, Chromium, Model studies.

The feasibility of adsorption onto amorphous iron hydroxide (am-Fe2O3-H2O) for the removal of a number of trace elements of concern in coal flyash wastewaters has been demonstrated. Adsorption behavior in simple, well characterized 'clean systems' provides a framework for interpreting adsorption in power plant effluents. Similar qualitative effects of changing adsorbate concentrations, changing pH, competing adsorbates, and complexing ligands are observed in both types of systems. High adsorptive removal of all cations investigated in the fly ash wastewaters can be achieved. Efficient removal of dilute concentrations of the oxyanions As(III), As(V), Se(IV) and V(V) from wastestreams can be achieved by adsorption onto am-FeO3-H2O. High concentrations of SO4 in the wastes limit removal of Cr(VI) and Se(VI) due to competitive adsorption effects. While removal of Se(VI) is severely limited by SO4 at all pH values, removal of Cr(VI) can approach 50%. Empirical removal curves can be developed from adsorption data for a trace element of interest in a particular wastewater to graphically illustrate the effect of iron dose and pH on trace element fractional adsorption. Preliminary results of adsorption modeling in wastewaters show quite good agreement with experimental data. Binding constants determined in a clean system and the measured wastewater composition were input into an equilibrium surface complexation model, the triple layer model (TLM). While the model cannot be considered to be truly predictive, the results can be useful in screening potential process operating parameters for subsequent pilot testing. (See also W89-10858) (Lantz-PTT)
W89-10900

NEW APPROACHES TO TREATMENT OF METAL-BEARING WASTES,
Washington Univ., Seattle. Dept. of Environmental Engineering and Science.
M. Edwards, M. Benjamin, and J. Ferguson.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 389-396, 9 fig, 1 tab, 4 ref. EPA Grant R810902-01-2.

Descriptors: *Wastewater treatment, *Heavy metals, *Industrial wastewater, Iron, Filtration, Hydrogen ion concentration, Cadmium, Nickel, Zinc, Sand filters.

A method is developed by which significant quantities of ferrihydrites may be firmly attached to silica surfaces. The Fe-coated sand has properties similar to unattached ferrihydrite in removing metals over a wide pH range. When used as a granular filtration media, the Fe-coated sand exhibited equal or higher soluble metal removals than sand alone. As these metal removals were completely reversible with pH for most metals, the indication is that regeneration of the Fe-coated

media would be as successful as that observed for free ferrihydrite. A column packed Fe-coated sand was successful in treating synthetic wastes composed of ammonia complexes of Cd, Zn and Ni. Nearly complete removals were achieved in treating as many as 20 bed volumes of waste, while no significant removals occurred in a column packed with sand alone. In several instances Fe-coated sand removed a greater portion of metal particulates present than did sand alone. These removals often occurred sooner upon entering a column packed with Fe-coated sand than uncoated sand, contributing to increased headlosses through constricting interstitial hydraulic flows. Under the conditions studied, the particulate penetration was dependent upon influent pH, with lowest penetration and highest headloss at pH 8.5, and highest penetration and lowest headloss at pH 10. The column packed with uncoated sand exhibited no headloss dependency with pH in the range 8.0 < pH < 10.0. Removed metals were effectively recovered during backwashing and acid regeneration from the Fe-coated media. Previous experiments suggest that those metals remaining attached would not affect subsequent metal removals. (See also W89-10858) (Lantz-PTT)
W89-10901

SORPTION OF SELECTED ORGANIC POLLUTANTS BY FLY ASH,
New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
K. Banerjee, P. Y. Horng, P. N. Cheremisinoff, M. S. Sheih, and S. L. Cheng.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 397-406, 8 fig, 7 tab, 8 ref.

Descriptors: *Wastewater treatment, *Organic compounds, *Fly ash, *Adsorption, Industrial wastewater, Hydrogen ion concentration, Molecular structure, Polarity, Chemical properties, Chemical treatment.

Studies have indicated that some clay soils can be used as liners to retard the mobility of hazardous leachate from landfill because of their low permeability, or can be used as a sorbent material to adsorb the pollutants from the waste stream. Many investigators have shown that leachate and waste streams containing organics, pesticides, herbicides, and heavy metals, can be attenuated by clay soils and thermal power plant by-products (fly ash). Some research has explored the application of fly ashs in treating wastewater. Fly ash was used as sorbent material throughout the study, and single dosage adsorbability tests data indicate that the use of fly ash is feasible for immobilization/isolation of hazardous organic pollutants, commonly found in the industrial waste streams. Percent reductions of the aromatic compounds are much higher compared to other functional groups such as alcohols, aldehydes and ketones. The low polarity and subsequent insolubility of the aromatics partially explains their easy removability. The effect of pH on fly ash performance indicates that maximum sorption of methyl isobutyl ketone, butyraldehyde, and ortho-xylene occurred at pH 4.50 to 6.00. Batch study data reveals that besides pH, molecular weight, polarity and the solubility of the compound has significant effect on the adsorption mechanism(s). These three parameters act simultaneously during the process. Fly ash favors adsorption of high molecular weight compounds. The adsorption capacity of fly ash increases, as the polarity of the compound decreases. Low water soluble compounds are removed more readily than high water soluble compounds. Data obtained from a multi-solute system show that the individual compounds in the mixture are each adsorbed to a lesser extent with respect to their relative adsorbabilities. The ultimate capacity of fly ash is considerably less than what would be predicted from summing the single-component data. This indicates that there must be considerable interaction between the compounds adversely affecting their respective adsorbabilities. The more apparent reasons for the relatively lower adsorbabilities are increased competition for adsorption sites. (See also W89-10858) (Lantz-PTT)
W89-10902

AMMONIA REMOVAL FROM WASTEWATER BY STEAM STRIPPING: A PROCESS EVALUATION,
Battelle Memorial Inst., Columbus, OH. Environmental Science Dept.
G. B. Wickramanayake, S. Khabiri, and E. A. Voudrias.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 407-414, 10 fig, 1 tab, 21 ref. EPA Contract 68-03-3248.

Descriptors: *Wastewater treatment, *Ammonia, *Steam stripping, *Model studies, Temperature, Sulfates, Ammonia, Potassium, Sodium, Magnesium, Iron, Hydrogen ion concentration, Chemical treatment, Lime, Sodium hydroxide.

The EQ3/EQ6, a chemical speciation and reaction-path geochemical model, was applied to investigate the effects of temperature, anions such as SO4(2-), and the type of chemical used for pH adjustment, such as lime versus caustic soda, on pH, amount of sludge generated, distribution of NH3, ionic strength of solution, and the Henry's Law constant (H sub e). The temperatures studied were 25 and 75 C. The SO4(2-) concentrations studied were 15,000, 25,000, and 34,000 mg/L. Two types of wastewaters were used for all the analysis. Wastewater A contained NH4(+), K(+), Na(+), Mg(2+), SO4(2-), Cl(-), and F(-). Wastewater B contained NH4(+), Na(+), Mg(2+), Cl(-), and SO4(2-). No significant effect on most of the variables was found as temperature increased from 25 to 75 C except the pH and Henry's Law constant. More lime or caustic is required to raise pH as the temperature increases. The ratio of Henry's Law constants (H sub e-solution/H sub e-aqueous) did not appear to vary significantly. However, increase in temperature from 25 to 75 C resulted in the overall increases of H sub e by 7.4 times. The results indicate that the temperature increase tends to decrease the free ammonia in ammonium ion ratio but improves the rate of volatilization of ammonia to a significant level. The effect of SO4(2-) ion concentration on the ammonia process was studied by varying SO4(2-) level from 15,000 mg/L to 34,000 mg/L. Increased SO4(2-) levels also resulted in increased amounts of sludge. Almost all the fluoride was removed by addition of lime to Plant A wastewater. Addition of NaOH to both Plant A and Plant B wastewaters did not produce any significant amounts of sludge. Changes in SO4(2-) levels did not appear to have any impact on the amount of sludge produced with caustic. The final pH achieved by lime addition was less than that achieved with NaOH. However, the amount of lime (by weight) required to reach the final pH is less than the amount of NaOH required to reach the same pH for both Plants A and B. This indicates that in some instances, addition of lime can be cost effective. Although lime addition generates more sludge than NaOH addition, the effluent quality can be better in terms of the lower amount of total dissolved solids. (See also W89-10858) (Lantz-PTT)
W89-10903

APPLICATION OF MEMBRANE SEPARATION TECHNOLOGIES TO INDUSTRIAL PROCESSES,
C3 International, Inc., St. Paul, MN.
P. S. Cartwright.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 415-423, 11 fig, 3 tab.

Descriptors: *Separation techniques, *Membranes, *Industrial wastewater, *Wastewater treatment, Ultrafiltration, Microfiltration, Filtration, Reverse osmosis.

In addition to the environmental pressures affecting dischargers of hazardous wastes, economic considerations are making 'point-of-source' recovery more and more attractive. Costs of both chemicals and water are steadily increasing; therefore, even where no discharge restriction exists, the application of technology to recover both solute and solvent may be justified. All of the membrane processes (microfiltration, ultrafiltration, reverse osmosis, and electrodialysis) utilize an engineering design known as 'crossflow' or 'tangential flow' filtration. In this mechanism, the bulk solution flows over and parallel to the membrane surface, and for microfiltration, ultrafiltration and reverse osmosis, because the system is pressurized, water is forced through the membrane. The turbulent flow of the bulk solution across the surface minimizes the accumulation of particulate matter on the membrane and facilitates continuous operation of the system. Microfiltration involves the removal of particulate or suspended materials ranging in size from 0.1 to 10.0 microns (100 to 100,000 angstroms). Ultrafiltration is used to separate materials in the 0.001 to 0.01 micron range (10 to 1000 angstroms). Basically, ultrafiltration is used to remove dissolved materials while suspended solids are removed by microfiltration. Reverse osmosis typically separates materials < 0.001 micron (10 angstroms) in size. Membrane separation technologies offer the following advantages over competing processes: continuous processing (not batch); low energy requirements (pumping only); modular construction; simple maintenance demands; positive barrier to contaminants; and ambient temperature operation. (See also W89-10858) (Lantz-PTT)
W89-10904

DESIGN OF AN EXPERT SYSTEM FOR EARLY ENVIRONMENTAL ASSESSMENT OF MANUFACTURING PROCESSES,
Merck Sharp and Dohme Research Labs., Rahway, NJ.
E. S. Venkataramani, G. Bamopoulos, A. L. Forman, and S. Bacher.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 425-433, 3 fig, 4 tab, 20 ref.

Descriptors: *Expert systems, *Design standards, *Wastewater treatment, *Waste management, *Computer models, Hazardous materials, Simulation analysis.

Waste reduction is a very comprehensive and difficult to define subject, and arriving at a precise definition is not a trivial exercise. Waste reduction refers to in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste so as to reduce risks to health and environment. There are five distinct approaches that industry can take to reduce the generation of hazardous waste, namely: (1) change the raw materials of production; (2) change production technology and equipment; (3) improve production operations and procedures; (4) recycle waste within the plant; and (5) redesign or reformulate end products. In recent years, there has been increased interest in the application of artificial intelligence techniques to diagnosis procedures in fields spanning medicine to engineering. The use of expert systems in wastewater treatment process diagnosis is also emerging. The 'PROVAL' system is a proprietary computer-aided batch process evaluation software package, conceived and developed by a team of computer scientists and developing engineers. PROVAL makes use of symbolic programming within an expert system environment, and has virtually unlimited expansion capabilities because its knowledge base is being continually added-to. PROVAL produces a preliminary batch process design. Its primary inputs are the unit operations and related process data required to transform a set of raw materials into the desired product. The system applies the appropriate engineering design methods in order to determine material and energy requirements, equipment sizes and time cycles. This information is then used to produce the desired econometrics. Since the whole PROVAL exercise is a simulation, the analysis can be performed for the same process with different sets of conditions within certain constraints. Thus, the process can be optimized from an environmental standpoint to achieve true reduction in waste generation. Since this is performed at a very early stage during process development, the findings of the analysis is fed back to the process development chemists and engineers who take a new look at the

process, aimed at minimizing the generation of hazardous waste. (See also W89-10858) (Lantz-PTT)
W89-10905

COALESCENCE/FILTRATION OF WATER-IN-OIL EMULSIONS,
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Virarghavan, H. K. Henning, F. Mourits, and R. Ranganathan.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 435-440, 1 tab, 5 ref.

Descriptors: *Wastewater treatment, *Filtration, *Oil wastes, *Emulsions, Chemical treatment, Fiberglass, Sand, Polypropylene, Coal, Temperature, Pressure.

Economical treatment methods for oily wastes and produced water will have a beneficial impact on the profitability and management of heavy oil and enhanced oil recovery operations. One area which is of significant interest to the petroleum industry in Saskatchewan and elsewhere relates to the breakdown of water-in-oil emulsions at production sites. These emulsions are produced in the natural state (heavy oil) or through enhanced oil recovery operations such as steamflooding or fireflooding schemes. These emulsions must be broken prior to the utilization of their hydrocarbon phase in the refinery, which is accomplished usually by the use of synthetic demulsifying agents. Results from laboratory-scale studies using fibrous bed coalescers indicate that > 95% oil removal is possible at a flow rate of 75 gallons per minute (gpm)/sq ft and an influent oil concentration to the coalescer in the range of 85 to 100 mg/L. The basic objective of the study was to investigate the use of various coalescing media for breaking down water-in-oil emulsions. The scope of the study included the following tasks: (1) characterization of emulsions; (2) laboratory studies of emulsions using a coalescer column employing four different types of coalescer media; and (3) an analysis of efficiency of the system under various operating conditions. The following media were used in the experiments: (1) fiberglass (Fiberglas*Pink, AW Insulation-Type 1, AF 110 Insulation); (2) polypropylene; (3) coal; and (4) sand. From the data and observations, the best medium was determined to be Fiberglas*Pink, which removed 41% of the water (initial water per cent-44%). The other two types of fiberglass products did not prove as successful but a fair amount of water was still removed. Polypropylene, as a medium, proved to be totally unsuccessful, and no water was seen to be dropping out when coal was used as a media. The ideal temperature was determined to be 70 C. At this temperature, the emulsion was easier to work with and the desired flow rates could be obtained. Pressure also played an important part in determining the amount of water broken out of the emulsion. (See also W89-10858) (Lantz-PTT)
W89-10906

ULTRAVIOLET PEROXIDATION: AN ALTERNATIVE TREATMENT METHOD FOR ORGANIC CONTAMINATION DESTRUCTION IN AQUEOUS WASTE STREAMS,
MAECORP, Inc., Homewood, IL.
K. W. Yost.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 441-447, 6 tab, 4 ref.

Descriptors: *Wastewater treatment, *Peroxidation, *Ultraviolet radiation, Organic compounds, Hydrogen peroxide, Polychlorinated biphenyls, Dioxins, Chemical reactions, Economic aspects.

Ultraviolet (UV) peroxidation is a new innovative technology which provides a cost-effective solution to media transfer of contaminants from one waste stream to another, by destroying them to their base components. Off-site disposal costs and liabilities are greatly minimized, and EPA regulation requirements for on-site remediation methods are satisfied. To properly implement the technology, energy and hydrogen peroxide costs must be correctly determined and compared to more traditional treatment methodologies. Studies have indicated that many organic constituents persistent in aqueous waste streams may be effectively destroyed given proper treatment time and doses of hydrogen peroxide and UV light. However, further testing and full scale installations are required to advance this existing data base. Such parameters as PCBs, dioxins, and others in aqueous solution appear to be of the proper molecular structure to be oxidized by UV peroxidation technology, but sufficient evidence has not been compiled for complete evaluation. The mobility of the system is ideal for remediation of hazardous waste sites whenever aqueous streams are present. Short-term installation (less than one year) allows for user companies such as environmental contractors to address on-site work and then move on to the next project. This removes the initial capital costs from the waste generator(s). Manufacturing entities with fixed waste streams will find UV peroxidation to be a viable and effective technology worthy of careful consideration. (See also W89-10858) (Lantz-PTT)
W89-10907

AMMONIA REMOVAL ALLOWS EFFLUENT REUSE AT FISH HATCHERY USING FLUIDIZED BED REACTORS,
Dworshak National Fish Hatchery, Ahsahka, ID.
D. E. Owsley, J. S. Jeris, and R. Owens.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 449-457, 10 fig, 4 tab, 4 ref.

Descriptors: *Water reuse, *Ammonia, *Water quality control, *Fish hatcheries, *Fluidized bed process, *Water treatment, *Wastewater treatment, Nitrification, Trout, Idaho.

Dworshak National Fish Hatchery, located along the Clearwater River in north central Idaho, was constructed as a reuse hatchery in order to produce a steelhead trout smolt in 1 year. This hatchery is unique because water temperature can be controlled through recirculation, similar to an aquarium. Ten million steelhead eggs are spawned and fertilized annually from the returning adult fish. From December 11, 1978 until early April, 1979, a fluidized bed pilot system was tested by the Corps of Engineers at the Dworshak Fish Hatchery to nitrify the hatchery water. The fluidized bed reactor consisted of a 6.5 inch diameter clear PVC pipe approximately eighty feet long. For about one month the reactor was fed a hatchery water supplemented with 1 to 5 mg/L of ammonium to enhance the seeding of the sand grains. Thereafter, the ammonium concentration was reduced to levels expected at the hatchery. Ammonium removals of 78-92% were obtained, and the process effectively maintained the level of ammonia far below the toxic point. The data indicate that the effluent concentration is related to the influent ammonium concentration. During these runs the highest effluent ammonium concentration observed was 0.11 mg/L when the influent ammonium was 0.46 mg/L. No backwashing is required so the units stay in continuous operation throughout the hatchery season. At the end of the season the reactors are chlorinated and drained. Start-up for the next season consists simply of turning the pumps back on. (See also W89-10858) (Lantz-PTT)
W89-10908

COUPLED BIOLOGICAL DOWNFLOW FLUID BED REACTOR TREATMENT OF SYNFUELS WASTEWATER,
North Dakota Univ., Grand Forks. Dept. of Civil Engineering.
C. D. Turner, C. S. Ong, and J. R. Gallagher.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 469-477, 11 fig, 1 tab, 10 ref. DOE Contract DE-FC21-86MC10637.

Descriptors: *Biological treatment, *Fluidized bed process, *Wastewater treatment, *Industrial wastewater, Synthetic fuels, Hydrogen ion concentration, Nitrification, Dissolved oxygen.

Synfuels processes, such as the Lurgi dry ash gasification process, produce wastewater with high concentrations of both organic and inorganic contaminants. These contaminants are difficult to remove prior to discharge and create operational problems if recycled back into the process. Cost-efficient production of synfuels can only take place if the technologies for production and waste management are developed prior to prototype plant construction. This research involved the application of coupled fluid bed reactors that combine nitrification and denitrification with organics removal in hydraulically connected anoxic and oxic columns for the treatment of synfuels wastewater from the Great Plains Gasification Plant (GPGP) near Beulah, North Dakota. The system is capable of both nitrifying and denitrifying GPGP stripped gas liquor (SGL) while removing biodegradable organics in the denitrification column. Successful operation of the process was dependent on pH control. This was especially important during system start-up because the GPGP SGL pH varied from 8.0 to 8.6. At these pHs, unionized ammonia concentrations were often > 30 mg/L and created toxic conditions. Nitrification was established intermittently during the first three months of operation. Only after adding acid to initially lower the pH and alkali in the 6.5 to 7.5 region was consistent nitrification possible. Denitrification was established quickly and was very stable as evidenced by the low nitrite and nitrate concentrations in the effluent. Dissolved oxygen concentrations must, however, be maintained at < 0.5 mg/L in the influent to the column. (See also W89-10858) (Lantz-PTT)
W89-10910

DEEP SHAFT BIOLOGICAL TREATMENT PROCESS,
Deep Shaft Technology, Inc., North York (Ontario).
P. G. Daly, and C. C. Shen.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 479-487, 5 fig, 4 tab, 6 ref.

Descriptors: *Biological treatment, *Wastewater treatment, Industrial wastes, Suspended solids, Biochemical oxygen demand, Mixed liquors, Organic compounds, Oxygen.

The Deep Shaft process is a high-intensity biological process for the treatment of sewerage and biodegradable industrial wastes. It works by circulating the sewerage in a deep shaft, divided into two sections, a downflow; or downcomer and an upflow; or riser section. The Deep Shaft comprises a single, vertical shaft in the ground typically between 150 and 500 ft deep, which is divided into upflow and downflow sections known, respectively, as the riser and downcomer. Raw wastewater and returned activated sludge are fed continuously to the downcomer and mixed with the very much larger volume of liquor recirculating within the shaft. Air, providing oxygen for the biological processes, injected into the downcomer and riser is carried to the bottom of the shaft and thus providing a long contact time and taking full advantage of the high hydrostatic pressure at the bottom of the shaft. This results in intense and efficient oxygen transfer while the modest injection depth and high proportional oxygen usage gives good power economy. The Deep Shaft plant at Molson's Brewery, Barne, Ontario, has consistently produced an effluent meeting sewer discharge standards. The average total biochemical oxygen demand (TBOD) and total suspended solids (TSS) concentrations are about 100 parts per million (ppm) and 100 ppm respectively, which is well below the pretreatment specification of 300 mg/L BOD and 350 mg/L TSS. Mixed liquor suspended solid (MLSS) concentrations range from 8000 to 14,000 mg/L, with the volatile fraction ranging from 62 to 73%. At design organic and hydraulic loadings the oxygen transfer efficiency is about 2.7 lb 02/kilowatt hr (kwh) of power applied. Specific oxygen uptake rates average 45 mg 02/g MLVSS/

h, ranging from about 240 mg 02/g MLVSS/hr at the point of injection. Approximately 54% of the oxygen entering the shaft is utilized in the biological process. Two other case studies cited in this paper had similarly favorable results to report from their use of the deep shaft process. (See also W89-10858) (Lantz-PTT)
W89-10911

USING A WASTE AUDIT APPROACH TO DETERMINE WASTE MANAGEMENT ALTERNATIVES AT A PRINTED CIRCUIT BOARD MANUFACTURING PLANT,
Canviro Consultants Ltd., Waterloo (Ontario).
R. C. Harries, K. C. Bradley, and D. Gardiner.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 489-497, 3 fig, 5 tab, 4 ref.

Descriptors: *Industrial wastewater, *Waste management, *Wastewater treatment, Copper, Water pollution sources, Waste disposal, Economic aspects, Regulations.

The implementation of increasingly complex and stringent environmental regulations have forced industries in North America to reconsider their approaches toward waste management and to re-evaluate the impact of environmental issues on their company's ability to survive in the market place. The emphasis is now on improving process efficiency, minimizing wastes and optimizing waste treatment and disposal practices to ensure compliance with discharge and disposal regulations. The best way to start is to conduct an in-plant survey or waste audit. This describes the application of the waste audit approach to determine the waste management alternatives available at a printed circuit board manufacturing plant in Waterloo, Ontario. The waste audit/reduction approach achieved the following objectives: provided a sound understanding of all the sources of waste copper at the manufacturing plant; identified and quantified the major sources of waste copper; permitted evaluation of processing efficiencies from assembled information on unit processors, products, raw materials, water usage, and waste generation; identified waste reduction opportunities; eliminated some wastes and associated disposal problems; identified 'problem wastes' requiring special attention; enabled the development of an efficient, integrated waste segregation and wastewater treatment/recovery system; and enabled the development of a waste management system capable of compliance with existing and proposed discharge regulations with resulting improved public relations. The nature of the waste management problems at a the company meant that a significant capital investment was required to achieve effluent discharge compliance. However, in many circumstances waste audit studies can result in significant cost savings and rapid paybacks on investment for companies, through improved processing efficiency, waste reduction and waste recovery. (See also W89-10858) (Lantz-PTT)
W89-10912

TREATMENT OF PLATING WASTEWATER WITHOUT SLUDGE,
Triad Engineering, Inc., Milwaukee, WI.
D. M. Boyd, and R. J. Fulk.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 499-504, 1 fig, 5 tab.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Chemical treatment, Sludge, Industrial wastes, Electrolysis, Electrochemistry, Copper, Waste recovery, Flow rates.

A printed circuit board plater has successfully operated a wastewater treatment system for the past year based solely on electrolytic recovery of copper and lead. All pretreatment standards are being met. In order to achieve the goal of eliminating physical-chemical treatment, the company had to: identify the pollutant sources, segregate waste streams, reduce rinse flowrates, and improve control of all batch dumps. Several metals can be successfully removed from different plating baths by electrolytic recovery. The system described is capable of removing 15 pounds of copper in 16 hours. In fact, the system has removed as much as 36 pounds of copper in just over 24 hours. (See also W89-10858) (Lantz-PTT)
W89-10913

UNIQUE METHOD FOR PRECIPITATING CERAMIC AND METAL COMPLEX WASTE PRODUCED IN MANUFACTURING MULTILAYER CERAMIC CAPACITORS,
Kyocera Northwest, Inc., Vancouver, WA.
A. Yato, D. M. Reeser, and P. E. McPherson.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 505-512, 3 fig, 1 tab, 4 ref.

Descriptors: *Wastewater treatment, *Chemical treatment, *Metal-finishing wastes, *Ceramics, Industrial wastewater, Lead, Nickel, Zinc, Barium, Magnesium, Filtration, Heavy metals, Hydrogen ion concentration, Separation techniques.

Kyocera Northwest Inc. owns and operates a ceramic capacitor manufacturing facility in Vancouver, Washington. The effluent streams from this facility contain particulate and dissolved lead, nickel, and zinc at quantities above the allowable discharge limits. The ceramic particulate contains various metals such as barium, lead, and magnesium, and due to its sub-micron size, it passes through a filter whose pore diameter is 0.45 micron. As a result, ceramic particulate system metals are subject to EPA regulations as dissolved metals. After assessing the Vancouver effluent and discharge requirements, it was concluded that the ionic solubilities of metals must be reduced by first creating hydroxides in order to remove them from the solution. In the course of process development, it was discovered that it was necessary to depress waste pH to at least 5.5 prior to raising the pH to the formation range of metal hydroxides. Data derived from laboratory bench tests suggest that the waste can be treated by a five-stage process: (1) metal complex destruction by lowering pH; (2) metal precipitation by raising pH to form hydroxide; (3) suspended solids removal through clarification and filtration; (4) trace metals removal through a deionizing polisher; and (5) solids dewatering. (See also W89-10858) (Lantz-PTT)
W89-10914

THERMOPHILIC ANAEROBIC DIGESTION OF COFFEE WASTEWATER,
Biothane Corp., Camden, NJ.
J. Lanting, J. A. Jordan, M. T. Schone, A. Kull, and W. W. Carey.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 513-524, 14 fig, 3 tab, 7 ref.

Descriptors: *Food-processing wastes, *Anaerobic digestion, *Wastewater treatment, *Thermophilic bacteria, Chemical oxygen demand, Biochemical oxygen demand, Biomass, Oil, Grease.

The treatability of coffee wastewater was assessed in four pilot studies under both mesophilic and thermophilic conditions. Both a 6 cu m and 10 L pilot reactor were used to generate about one year's worth of operating data. Under mesophilic conditions it was not possible to sustain stable anaerobic digestion of coffee wastewater for more than seven weeks. The granular biomass in the BIOTHANE 10 L reactor easily made the transition from a mesophilic to a thermophilic mode of operation. Net growth of granular biomass was not conclusively demonstrated. A 6 cu m reactor study would be more suitable for that purpose. For the entire duration of the thermophilic study: i.e., a period of four months of continuous operation, coffee wastewater was successfully treated with the BIOTHANE system. High concentrations of oil and grease and the resulting grease deposits in the settler area caused operational problems with the 10 L reactor during the mesophilic pilot trial. Under thermophilic conditions there was no appreciable accumulation of deposits. The addition of micro-nutrients appeared to improve reactor stability, and may be essential to achieve consistent treatment results. During thermophilic treatment of coffee wastewater using a BIOTHANE upflow anaerobic sludge blanket system, 60 to 70% of the chemical oxygen demand (COD) and biochemical oxygen demand, and 80% of the oil and grease were removed from the wastewater. The removal efficiencies for total and soluble COD were 9 and 34% better respectively than during mesophilic treatment of the same wastewater. (See also W89-10858) (Lantz-PTT)
W89-10915

ANAEROBIC TREATMENT OF WINERY WASTEWATERS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
J. K. Farmer, A. A. Friedman, and W. C. Hazen.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 525-534, 7 fig, 4 tab, 2 ref.

Descriptors: *Food-processing wastes, *Anaerobic digestion, *Wineries, *Wastewater treatment, Biochemical oxygen demand, Chemical oxygen demand, Biomass, Biological treatment, Economic aspects, Operating costs.

Winery wastes from the Canandaigua Wine Company are treated on-site with an extended aeration treatment system prior to discharge to the publicly owned treatment works (POTW). During the last few years, expended winery activities have resulted in overloading of the pretreatment system and occasional contravention of POTW pretreatment standards. A pilot plant study was conducted with an upflow anaerobic sludge blanket (UASB) reactor followed by an aerobic polishing reactor. The UASB process was selected based on several factors, including the ability to treat high organic loading rates, the successful operation of numerous full-scale UASB systems, reported resistance to upset, and economic considerations. Once a mature biomass developed, the pilot system (UASB and continuous flow stirred tank reactor (CFSTR)) operated successfully, removing > 99% of the applied soluble chemical oxygen demand (SCOD) and BOD. During the latter part of the pilot study, targeted COD loading rates (15 kg COD/cu m/day) were achieved. The methane gas yield during the pilot study averaged 0.32 L/gm of SCOD removed. Net sludge production resulting from anaerobic contact treatment followed by aerobic polishing was estimated to be 20 to 30% of that which would result from aerobic treatment alone. Pilot study results suggest that biomass solids production would be on the order of 8% of the mass of organic substrate removed. Chemical requirements for a full-scale anaerobic system would include sodium hydroxide to provide alkalinity, and ammonium hydroxide and phosphoric acid to provide nutrients for biomass growth. Current estimates suggest that the annual cost of chemical for treatment of 125,000 gallons per day and 7,500 kg COD/day would be about $52,000. (See also W89-10858) (Lantz-PTT)
W89-10916

TREATMENT OF SEAFOOD PROCESSING WASTEWATER BY DISSOLVED AIR FLOTATION CARBON ADSORPTION AND FREE CHLORINATION,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, L. K. Wang, and C. D. Pollman.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 535-550, 1 fig, 12 tab, 71 ref. Homer Smith Seafood Co. Grant J8503-37.

Descriptors: *Wastewater treatment, *Adsorption, *Chlorination, *Food-processing wastes, Chemical treatment, Chemical oxygen demand, Suspended solids, Biochemical oxygen demand, Cadmium, Zinc, Copper, Phosphorus, Bioassay, Costs, Flotation, Activated carbon.

In laboratory testing and on-site pilot plant demonstration, a wastewater treatment system consisting

of a microstrainer, a dissolved air flotation clarifier (DAF) and a granular activated carbon (GAC) column was proven to be technically feasible for treatment of the target 200 gallon/minute (gpm) Homer Smith Seafood (scallop) Company processing wastewater containing 2600-3184 mg/L chemical oxygen demand (COD), 1525-1905 mg/L total suspended solids (TSS), 1238-1250 mg/L biochemical oxygen demand (BOD), 114-122 ppb cadmium, 346-387 ppb zinc, 117-224 ppb copper, 145-150 mg/L TKN, 50 mg/L total phosphorus, and 27.7-37.5 mg/L ammonia nitrogen. Dissolved air flotation (DAF) alone removed significant amounts of COD, BOD, TSS, ammonia nitrogen, cadmium, copper, TKN, total phosphorus and coliforms and zinc. Bioassay testing indicates that the effluent generated from a continuous DAF pilot clarifier was not toxic to fish. Tertiary treatment of DAF effluent by GAC further removes ammonia nitrogen, COD, and heavy metals. Final DAF-GAC effluent gave extremely high removal of COD and ammonia nitrogen. Tertiary treatment of DAF effluent by the mixed ion exchange resins (IE-M) was also successful in terms of trace metals. The chemical treatment cost at Homer Smith is estimated to be $0.8146/1000 gal., or $78.20/day. (See also W89-10858) (Lantz-PTT)
W89-10917

ANAEROBIC TREATMENT OF APPLE POMACE AND WASTEWATER,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
T. E. White, D. J. Malecki, and W. J. Jewell.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 551-560, 8 fig, 5 tab, 9 ref. New York State Energy Research and Development Authority Contract 803-RIER-IER-86.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Food-processing wastes, Apples, Costs, Biodegradation, Biological treatment, Fermentation, Hydrolysis.

Anaerobic digestion of apple wastes without nutrient or buffer addition results in a low cost alternative to current disposal practices. The total biodegradability of pomace volatile solids is 90% indicating that pomace has an available energy content of $20 to $30 per ton. Wastewater treatment, either combined or separate, could increase energy recovery and lower final treatment costs. The differences between fermentation and organic removal rates indicate that low solids retention time (SRT) conditions can achieve phase separation, but fermentation efficiencies may be quite low due to inhibition of the acidogenic phase. High SRT conditions, on the other hand, appear to offer increased hydrolysis rates at acceptable fermentation efficiencies but limited phase separation. Interestingly, low temperatures may offer the best choice for high efficiency, phase-separated digesters. (See also W89-10858) (Lantz-PTT)
W89-10918

BENCH-SCALE EVALUATION OF THE ANAEROBIC CONTACT PROCESS FOR TREATING ICE CREAM NOVELTY WASTEWATER,
Applied Technologies, Inc., Brookfield, WI.
L. E. Ripley, D. E. Totzke, and I. C. Hwang.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 561-567, 10 fig, 1 tab, 5 ref.

Descriptors: *Anaerobic digestion, *Food-processing wastes, *Wastewater treatment, Biological treatment, Suspended solids, Chemical oxygen demand, Methane, Biochemical oxygen demand, Performance evaluation.

The Gold Bond Ice Cream plant in Hagerstown, Maryland, discharges an average of 60,000 gallons per day (gpd) to the City of Hagerstown public operated treatment works (POTW). Plant wastewater is generated during the cleaning of the production equipment and during the clean-up of product spillage. As a result, the wastewater flow and strength vary considerably over the course of a normal 24-hr production day. Because of the high levels of biochemical oxygen demand (BOD) (7,000 to 9,000 mg/L), and total suspended solids (3,000 to 5,000 mg/L), attention was focused on anaerobic treatment as the preferred pretreatment technology. The anaerobic contact process was found to be suitable for treatment of the wastewater from an ice cream novelty plant. The wastewater fats never caused a foam or scum problem in the bench-scale digesters. The process can produce excellent effluent quality. At a 7.5-day hydraulic retention time (HRT), with an average organic loading rate of 1.7 g chemical oxygen demand (COD)/L/d and influent total suspended solids (TSS) of 5,870 mg/L, the effluent COD was 628 mg/L, BOD was 91 mg/L, and TSS was 674 mg/L. The effluent TSS is highly dependent on the influent TSS. Methane yields were high: 268 mL/g COD added during several weeks of pseudo-steady-state testing. The mixed liquor settled well, with a zone settling velocity of 7.0 m/d (170 ga/sq ft/d) at 4.5% TSS. No nutrients were required to reach the observed methane yields; however, 41 milliequivalents (mEq)/L of lime or caustic were required to keep the digester pH above 6.8. (See also W89-10858) (Lantz-PTT)
W89-10919

STATIC PILE COMPOSTING OF CRANBERRY RECEIVING WASTES AND PROCESSING RESIDUES,
Northeastern Univ., Boston, MA. Dept. of Civil Engineering.
F. C. Blanc, and J. C. O'Shaughnessy.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 569-578, 4 fig, 7 tab.

Descriptors: *Food-processing wastes, *Composting, *Wastewater treatment, Waste disposal, Cranberries, Farm wastes, Organic matter, Hydrogen ion concentration, Landfills, Biochemical oxygen demand, Chemical oxygen demand.

Cranberry fruit receiving and cranberry processing operations produce a large amount of solid waste which is presently being disposed of by landfilling in some locations. Because of the agricultural nature of the waste products, the opportunity of composting to produce a soil conditioner is attractive. The results from a large static pile pilot composting study conducted on such residues in the winter and spring of 1985 are presented. The wastes in this study may be characterized as vines, pulp, screenings, leaves, rice hulls and berries. These materials are organic in nature, low in available nutrients, and low in pH (in the 2.5 to 4.5 range). After the February 8th setup of three static piles, temperature measurements were taken three days/week from all temperature probes to monitor the progress of the piles. Temperature increases indicate increased biological activity. In piles number 2 and number 1, temperatures indicated that they were in the active composting stage after one month. Pile number 3 did not reach high temperature levels until two and one-half months after setup. On April 19th, after 70 days, samples of the composting material were taken from all three piles. The samples were analyzed for moisture and volatile matter content; moisture in the 60 to 70% range, and on a dry weight basis the volatile matter was in the 78 to 92% range. Data presented indicates that the lime addition to compost Piles number 1 and number 2 provided adequate buffering while the natural buffer created by decomposition in Pile number 3 was not enough to maintain the pH in a desirable range. The COD and BOD values indicate that Pile number 2 did not have a great deal of available (soluble) substrate to maintain a high decomposition rate. Pile number 3 had not undergone very much decomposition and it therefore provides an indication of the available substrate in the early stages of decomposition when the temperature is rising rapidly. An estimate of this amount calculated from the data is 9,450 mg/kg on a wet weight basis or 28,600 mg/kg on a dry weight basis. The BOD/COD ratios for the piles ranged from 0.4 to 0.6 with Pile number 2 having the lowest ratios and Pile number 3 having the highest. (See also W89-10858) (Lantz-PTT)
W89-10920

CO-PRECIPITATION OF HEAVY METALS WITH CHROMIUM IN BRASS MILL WASTEWATER,
Cerro Metal Products, Bellefonte, PA.
M. J. Pardus, and R. W. Regan.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 579-586, 2 fig, 10 tab, 9 ref.

Descriptors: *Wastewater treatment, *Chemical precipitation, *Heavy metals, *Chromium, *Metal-finishing wastes, Brass, Lead, Nickel, Hydrogen peroxide, Sulfuric acid, Economic aspects, Costs, Chemical treatment.

Many industries are being faced with the need to improve their waste management procedures, specifically when hazardous and toxic wastes (HTW) are involved. This case study is a presentation concerning a brass wire operation of an integrated brass and bronze mill (Cerro Metal Products, Bellefonte, PA). The following were explored in detail: (1) bench scale evaluation of the impact of chromic acid and peroxide pickling on the removal of metals from process wastewaters; (2) comparison of bench scale results to the full scale operation of the pretreatment system during operation with each type of pickling solution; (3) observation of the impact of chromium when precipitated with other heavy metals; and (4) documentation of actual costs under various treatment schemes. Treatment of the wire mill wastewaters using caustic neutralization/membrane ultrafiltration technology exhibited a metal removal efficiency of greater than 99% for Cr(3+), Cu and Zn and a removal efficiency of > 90% for Pb and Ni. Effluent metal concentrations averaged < 0.1 mg/L except for Zn which averaged < 0.3 mg/L. The presence of Cr(3+) was found to have a beneficial impact (co-precipitation) on the removal of these metals by hydroxide precipitation. However, this benefit was out-weighted by the potential environmental liabilities associated with Cr(6+) in the wastewater. Substitution of stabilized hydrogen peroxide-sulfuric acid solutions for chromic acid required more stringent control over waste treatment plant operations. Overall, cost-effective compliance with federal environmental regulations was achieved. An audit of existing plant processes and implementation of technology alternatives has resulted in significant improvements in waste treatment efficiency, hazardous and toxic waste minimization and reduced waste treatment costs. Use of the hydrogen peroxide pickling solution has been found to maintain product quality in the wire mill. (See also W89-10858) (Lantz-PTT)
W89-10921

ALUMINUM DIE CASTING WASTEWATER SYSTEM,
Alabama Univ., University. Dept. of Civil Engineering.
J. Ball, and J. R. Bonner.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 587-592, 2 fig, 4 tab, 3 ref.

Descriptors: *Aluminum, *Metal-finishing wastes, *Wastewater treatment, Oil, Separation techniques, Adsorption, Industrial wastewater, Heavy metals, Phenols, Organic compounds, Activated carbon, Chemical coagulation.

A study was conducted of the wastewater generation and treatability from an aluminum die casting facility located in a small town in northwest Alabama. Initially, the effluent was being discharged untreated. However, because of the new and very stringent EPA discharge limits for this industry, the company was required to install a pretreatment system having the effluent quality that was essentially below the detection limits for most of the parameters. The system includes oil-water separation, chemical coagulation and settling followed by activated carbon adsorption. The wastewater was treated easily by oil-water separation for free oil

removal followed by chemical coagulation for metals, phenol, and total toxic organics removal. However, considerable effort was required before it was determined what specific chemicals, mixing energy, chemical dose, and chemical addition point were best in order to sustain good treatment. Once a clear effluent was obtained, good removal followed with the exception that oil and grease concentrations could not meet the extremely difficult requirements of < 0.1 mg/L. (See also W89-10858) (Lantz-PTT)
W89-10922

USE OF A BIOLOGICAL MEANDER TREATMENT SYSTEM FOR LEAD MINE/MILL WASTES IN SOUTHEAST MISSOURI, U.S.A.,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
M. Z. Erten, J. L. Pitt, N. L. Gale, B. G. Wixson, and E. Hindenberger.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 617-629, 21 fig, 4 tab, 13 ref.

Descriptors: *Wastewater treatment, *Toxicity, *Biological treatment, *Lead, *Mine wastes, *Water pollution effects, Missouri, Industrial wastewater, Hydrogen ion concentration, Zinc, Lead, Minnows, Groundwater pollution, Lethal limit, Bioassay.

The meander system which has operated at the Buick Mine-Mill Complex in Missouri since 19770, continues to provide adequate treatment of the combined mine-mill wastewater produced at this industrial site. This low-cost, low maintenance system routinely produces effluent which meets or surpasses the stringent guidelines established by state and federal regulatory agencies. It achieves this through application of biological and physical processes which effectively trap, bind and retain heavy metal-containing particulate matter as well as other potential pollutants. The high pH and alkalinity of regional ground and surface waters assure limited solubility and lowered toxicity of lead and zinc, the principal metallic industrial wastes of this industrial complex. Preliminary static, acute toxicity tests using Fathead minnows affirm that Pb and Zn salts are much less toxic in hard, alkaline waters typical of Ozark rivers and streams. More than 3000 mg Pb/L, introduced as the sulfate, chloride, carbonate, sulfide, or oxide salt may be suspended in typical Ozark groundwater without causing mortality of the newly-hatch Fathead minnows. Increased mortality at concentrations of the chloride, sulfate, and oxide salts above 3500-4000 mg/L Pb appears to be partly due to the removal of protective carbonates initially present in the hard water by coprecipitation with metal ions. Zinc salts appear to be considerably more toxic when suspended in similar conditions. In some test, < 10 mg/L Zn, added as ZnSO4, or < 80 mg/L added as ZnCl2 may be sufficient to cause 100% mortality of the test organisms. Carbonate, oxide and perhaps sulfide salts are much less toxic under these conditions, showing insignificant mortality up to about 300 mg/L Zn. The exact cause of death in test organisms exposed to Pb and Zn salts is unknown, yet it is obvious that ingestion of large amounts of Pb and Zn salts by fasting, newly hatched minnows is not entirely responsible. (See also W89-10858) (Lantz-PTT)
W89-10924

DESIGN CONSIDERATIONS FOR PACKED COLUMNS REMOVING MANGANESE FROM MINING SEEPAGE,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
J. A. Gordon, N. S., Chuang, and R. P. Wallace.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 631-639, 8 fig, 2 tab, 6 ref.

Descriptors: *Water pollution treatment, *Wastewater treatment, *Manganese, *Mine wastes, *Chemical precipitation, Chemical treatment, Hydrogen ion concentration, Chemical reactions, Sandstones.

Three columns packed with different media were used to study the efficiency of manganese removal, as measured during upflow operation. Columns packed with sandstone from Sand Mountain, Alabama, and chert from the Duck River near Normandy, Tennessee, can remove soluble manganese from a laboratory prepared solution. The manganese is precipitated and remains within the column as MnO2. The controlling factors in the removal process are hydraulic loading, depth of the column, mass loading and influent pH. Hydraulic loading and depth are the most important factors. Mass loading is less a factor in performances between 0 and 20 mg/L of Mn(2+). Previous work has shown that pH should be above 6 for successful applications. The limited mechanisms data presented here still indicate that most of the manganese is removed by bacterially mediated processes. (See also W89-10858) (Lantz-PTT)
W89-10925

DESIGN, CONSTRUCTION AND START-UP OF AN ANAEROBIC TREATMENT SYSTEM FOR PHARMACEUTICAL WASTEWATER,
Abbott Labs., North Chicago, IL.
D. A. Schlott, S. G. Charbonneau, J. A. Greiner, R. E. Green, and D. E. Quane.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 651-660, 9 fig, 3 tab.

Descriptors: *Anaerobic digestion, *Pharmaceutical industry, *Wastewater treatment, *Design standards, Industrial wastewater, Hydrogen ion concentration, Alkalinity.

Abbott Laboratories, a health care products manufacturer, operates a large fermentation and chemical synthesis plant in North Chicago, Illinois. The wastewater from these operations has historically been treated in an extended aeration activated sludge system. In April of 1985, Abbott initiated a project to evaluate expansion alternatives for its wastewater treatment system. From this analysis, the anaerobic technology was a clear winner. A low-rate anaerobic system was selected and has been in operation for almost nine months. After an initial high period of gas production (weeks 15 to 20) and a subsequent decline, the system has shown steady improvement and appears to be stabilizing. The performance experienced to date reinforces the fact that start-up of an anaerobic system requires close monitoring and attention. Some of the key factors noted thus far during start-up include: (1) quality and quantity of initial seed material; (2) a particularly sensitive pH balance during start-up before the reactor alkalinity has been established; (3) a need for tight control of raw waste pH; (4) a controlled increase in organic loading based on overall 'health' of the system, rather than a fixed schedule based upon pilot plant experience; and (5) establishing controls and procedures to minimize excessive solid losses from the reactors. With increased operating experience and recognition of the factors affecting performance, system modifications and operating protocols have been implemented to keep the system start-up on track. As a result of these efforts, the system performance and reliability continue to improve towards the design level, and the objectives originally envisioned for this project (capacity, improved effluent quality, and cost savings) are fully expected to be achieved. (See also W89-10858) (Lantz-PTT)
W89-10926

EFFECT OF REACTOR CONFIGURATION ON OPERATION OF A PHARMACEUTICAL WASTE TREATMENT SYSTEM,
Merck and Co., Elkton, VA. Merck Chemical Mfg. Div.
D. J. Wolf, and D. K. Emerson.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 661-672, 8 fig, 3 tab, 7 ref.

Descriptors: *Wastewater treatment, *Pharmaceutical industry, *Biological treatment, Nitrification, Denitrification, Aeration, Microbial degradation, Biomass, Bacteria, Settleable solids.

A complete mixed nitrifying activated sludge waste treatment system, treating 1.2 million gallons/day (MGD) (10,000 -15,000 kg biochemical oxygen demand (BOD)/day) of pharmaceutical wastewater from both synthetic and fermentation chemical processes, has experienced severe filamentous bulking and periods of very poor settling (no settling at all in a static settling test). The activated sludge contains excessive levels of Type 0092 and Type 0675 filamentous organisms and high levels of Halilscomenobacter hydrossis and Nostocoida limicola I. organisms typically associated with low F/M operation. The system operating parameters are as follows: solids retention time (SRT) 5-9 days, mixed liquor suspended solids (MLSS) 3,000-5,000 mg/L, temperature 35 C, hydraulic retention time (HRT) 2 days, and F/M 0.2-0.5. A pilot study program was developed to gain an understanding of the bulking problem. Operation with the tail series basin at a reduced dissolved oxygen (DO) level (0.5 mg/L compared to 2-4 mg/L) alleviated excessive denitrification and floating sludge in the clarifiers. This may be due to one or both of the following: (2) the low DO inhibited nitrification in the tail basin and therefore reduced the concentration of nitrate accumulated in the aeration system; and (2) the low DO increased denitrification in the tail basin which in turn lowered the nitrate influent to the clarifiers. Filamentous bulking caused by a combination of Type 0092, Type 0675, Haliscomenobacter hydrossis, and Nostocoida limicola I filamentous organisms in a complete mixed aeration system can be controlled by conversion to a compartmented series flow pattern with equal volume aeration chambers. Altering the aeration flow pattern of a complete mixed nitrification system to series flow may affect relative rates of nitrification/denitrification. The 64-69 L pilot bioreactors with actual waste feed accurately predicted the general behavior of 1.6-2.4 million gallons full scale activated sludge system operated under similar conditions. (See also W89-10858) (Lantz-PTT)
W89-10927

TOTAL CLOSING OF PAPER MILLS WITH RECLAMATION AND DEINKING INSTALLATIONS,
Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 673-687, 12 fig, 2 tab, 18 ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Pulp wastes, *Water reuse, *Recycling, *Ink, Anaerobic digestion, Industrial wastewater, Polymers, Water pollution treatment, Filtration, Flotation.

Closing up of a water system involves a custom-made approach for each paper mill, due to the many individualities of each existing mill's installation. A small amount of fresh makeup water must always be added, on the order of 250-500 gallons/dry ton of stock. The dispersed air flotation cell (Foamer), dissolved air flotation (DAF) cell (Supracell) are the major components of the newly developed total water recycle deinking system. Both types of air flotation cells can prevent anaerobic buildup in the system because of their extremely short detention time and high oxygen content. Conventional sedimentation clarifiers (or settling cones) are generally not acceptable in a totally closed system because of its large volume, thin settled sludge, long detention time and possible anaerobic problems. Dispersed air flotation (Foamer) is the most effective means for separating ink from fiber and clay, with very small water and material loss. The use of organic polymers in DAF cells is preferred due to the small amount of material added, the fact that they can be removed by DAF clarification, and the fact that polymers do not change the system pH. Spray filter is a fractionation process unit for separation of long fibers from low-consistency stock by its microscreens (50 to 300 micron opening size). The spray filter is an optional facility highly recommended by the authors for long fiber recovery. The benefits of a closed deinking paper mill both in increased proc-

ess efficiency and 'zero wastewater discharge' are considerable. In most cases, the closed system pays for itself without even considering the pollution control benefits. For instance, tissue machines changing from cold fresh water to recycled warm water for felt cleaning have experienced paybacks of one year or less on equipment investment on screens and DAF cells. In addition to heat savings, the savings on the recovered fibers, clays, dissolved solids, chemicals, and of course, water are all significant. (See also W89-10858) (Lantz-PTT)
W89-10928

ON-SITE ANAEROBIC TREATMENT PROVES HIGHER DESIGN LOADING RATE AT LAKE UTOPIA PAPER LIMITED,

Paques Lavalin, Willowdale, Ontario, Canada M2J 5A6.
A. M. D. Ferguson, K. G. Conrod, and J. R. Frenette.

IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 689-697, 12 fig, 3 tab, 4 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Pulp and paper industry, Industrial wastewater, L'Etang Estuary, New Brunswick, Chemical oxygen demand, Biochemical oxygen demand, Methane, Nitrogen, Phosphorus, Biological treatment, Sludge.

Lake Utopia Paper Limited operates a 300 ton/d corrugating medium mill at St. George, New Brunswick. The L'Etang Estuary is the receiving water for mill effluent. The Provincial Environment Department has ordered the mill to reduce its discharge to 3,700 pounds of biochemical oxygen demand (BOD)/d and 14 pounds of suspended solids (SS)/ton of paper produced. Anaerobic pilot plant studies on pulp and paper effluents carried out by Environment Canada's Wastewater Technology Centre indicated that this wastewater could be treated by anaerobic methods. An on-site demonstration program carried out using anaerobic technology confirmed these findings. To confirm the above results and to establish design parameters for a full-scale treatment plant a 6 month on-site pilot plant study was conducted using an upflow anaerobic sludge blanket (UASB) reactor. Stable operation at a volumetric loading rate (VLR) of 20 kg chemical oxygen demand (COD)/cu m/d was verified and can be used for full-scale design. The average COD and BOD removal at this VLR was 55% and 83%, respectively. At a daily peak VLR of 1.7 times the design VLR of 20 kg COD/cu m/d stable performance was maintained. Granular sludge growth and accumulation was proven. NaOH was required for start-up but was not required for steady-state operation. To achieve adequate preacidification of the wastewater an hydraulic retention time (HRT) of 2 hours was sufficient. Methane production was 0.35 cu m/kg COD/d. N and P must be added at a COD:N:P ratio of at least 700:5:1 for adequate biological growth. The pilot plant demonstrated the ability to recover from expected mill organic and hydraulic shock loads. Based on the success of the pilot plant study, Lake Utopia Paper Ltd. is proceeding with the construction of a full-scale anaerobic treatment plant. (See also W89-10858) (Lantz-PTT)
W89-10929

REMOVAL OF HYPOPHOSPHITE AND PHOSPHITE FROM ELECTROLESS NICKEL PLATING BATHS,

Occidental Chemical Corp., Grand Island, NY.
W.-C. Ying, R. R. Bonk, and M. E. Tucker.

IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 699-706, 2 fig, 8 tab, 13 ref.

Descriptors: *Metal-finishing wastes, *Hypophosphates, *Phosphites, *Nickel, *Wastewater treatment, Hydrogen ion concentration, Chemical precipitation, Chemical treatment, Lime, Dissolved oxygen, Potassium permanganate, Oxidation, Phosphorus, Sodium hydroxide.

Electroless nickel plating (EN) is a popular commercial technique for depositing nickel coating on a suitably treated surface by controlled chemical reduction of nickel ions. The major types of wastewater resulting from EN process are spent EN baths, stripping solutions, and rinse waters. The spent baths contain large amounts of total soluble nickel species (Ni(II), reducing, and complexing agents. Ni(II) can be removed either by NaOH or Ca(OH)2 as Ni(OH)2 or NaBH4 as Ni. Direct one-step methods for removing hypophosphite and phosphite are either ineffective, i.e., lime precipitation, or too costly, i.e., ion exchange. Therefore, initial chemical oxidation, for converting hypophosphite to phosphite and then to phosphate, followed by lime precipitation, for removing both phosphate and nickel, was investigated in this study for treatment of spent EN baths. A significant fraction of PO3-P was removed by lime precipitation. More complete removal was achieved at pH=10 as CaHPO3, than at pH=4 as Ca(H2PO3)2. Lime treatment removed most of Ni(II), as Ni(OH)2, and PO3-P, as CaHPO3, in EN-B and EN-C; however, post chemical oxidation and further lime treatment were necessary to meet stringent effluent limits, such as 1 mg/L in Ni(II) and/or Total-P. Dissolved oxygen was able to oxidize PO2-P to PO3-P; however, no PO4-P was produced after several days of aeration. Potassium permanganate was the most effective oxidant studied. It would complete oxidation of PO2-P and PO3-P to PO4-P in less than one hour at room temperature. The presence of organic acids, which competed for KMnO4, also adversely affected oxidation rate and overall conversion. The three-stage treatment scheme--preliminary lime treatment for removing the bulk of PO3-P, followed by oxidation of PO2-P/PO3-P to PO4-P, and final lime treatment--was developed and employed successfully in treating three actual EN baths of differing compositions. Relative to the two-stage oxidation-lime treatment, the three-stage treatment achieved more complete removal of both nickel and phosphorus yet at a much lower chemical cost. With proper modification, the precipitation-oxidation-precipitation process can be applied to treat most spent EN baths, at a cost less than off-site disposal alternatives. (See also W89-10858) (Lantz-PTT)
W89-10930

USE OF INNOVATIVE TREATMENT TECHNOLOGIES TO UPGRADE PERFORMANCE OF AN EXISTING PRETREATMENT SYSTEM TO MEET NEW DISCHARGE STANDARDS,

Radian Corp., Milwaukee, WI.
J. E. Kane.

IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 707-710, 2 tab.

Descriptors: *Wastewater treatment, *Pretreatment, *Metal-finishing wastes, Case studies, Heavy metals, Chemical treatment, Oxidation, Iron, Flocculation, Magnesium hydroxide, Permits.

A case history is presented describing the process used to upgrade an inadequate pretreatment system to meet new, more strigent discharge standards. The modification of the existing system included incorporation of several innovative treatment technologies to achieve program goals. A large midwestern home appliance manufacturer utilizes an automated electroless nickel plating line in its dishwasher production operation. Components of this system include an alkaline cleaner, sulfuric acid pickling, nickel plating and various hot and cold water rinses. Wastewaters from this operation and other process wastewaters produced at this facility are discharged to the collection system of a sewage treatment plant serving a large metropolitan area. The facility was issued a discharge permit by the local authority setting limits on the concentration of heavy metals allowable in the electroless nickel process wastewater and the total facility discharge. A pretreatment system was designed and installed to reduce heavy metal concentrations in the electroless nickel wastewater and achieve compliance with all permit limitations. Iron oxidation by aeration was selected as the optimal solution to the soluble iron problem. Improvement in the chemical flocculation process and the substitution of magnesium hydroxide as the coagulant significantly reduced the sludge volume problem and improved sludge dewatering characteristics. In addition to these process changes, relatively minor equipment changes significantly improved system performance and effluent quality. The changes made as a result of this program will insure facility compliance with all existing and future permit limitations. (See also W89-10858) (Lantz-PTT)
W89-10931

SELECTIVE CYANIDE RECOVERY FROM WASTEWATER CONTAINING METAL CYANIDE COMPLEXES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, and Y. Y. Chang.

IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 711-719, 14 fig, 2 tab, 15 ref.

Descriptors: *Recycling, *Cyanide, *Wastewater treatment, *Chemical treatment, Membranes, Hydrogen ion concentration, Ion exchange, Chemical reactions, Chemical precipitation.

A new metal cyanide separation technique has successfully combined a gas membrane and an ion exchanger to recover the metal and cyanide content of metal cyanide-bearing wastewaters. These wastewaters have an alkaline pH generally above 11 and under these conditions cyanide ions bind the metal to form complex anions such as Zn(CN)4(2-) and Cd(CN)4(2-). Recovery of cyanide from acidified zinc and cadmium cyanide solution is fast and complete when solution pH is < 2.0, since all the cyanide is in the HCN form. Above pH 2.0, the rate of cyanide recovery was slowed by the low percentage of HCN present at equilibrium. In concentrated zinc cyanide solutions such as may be encountered during regeneration, the pH required to convert all the complexed cyanide to HCN will decrease. To achieve good regeneration, a strong acid solution and sufficient contact time must be provided to ensure complete cyanide removal. A kinetic model interfaced with chemical equilibrium model successfully predicted the rate of cyanide recovery as a function of operating pH. Agreement between the predicted and the observed cyanide recovery rates indicated that the dissolution kinetics of Zn(CN)2 do not appear to limit the cyanide recovery rate. Rather, the rate is controlled by the cyanide speciation equilibria. Cyanide can not be completely recovered simply by acidification of concentrated copper cyanide solutions because of the formation of cuprous cyanide precipitate. With addition of FeCl3, cuprous cyanide precipitate can be oxidized and cyanide can be completely recovered in the NaCN form. Under acidic conditions it is not possible to oxidize cuprous cyanide to cyanogen gas with FeCl3. The ferric ion appears to oxidize copper to cupric form with the release of HCN. (See also W89-10858) (Lantz-PTT)
W89-10932

TREATMENT AND METAL RECOVERY FOR ELECTROLESS METAL PLATING WASTES,

Recycle Metals, Glastonbury, CT.
C. S. Brooks.

IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 721-726, 4 fig, 4 tab, 5 ref.

Descriptors: *Recycling, *Waste recovery, *Wastewater treatment, *Heavy metals, *Metal-finishing wastes, Copper, Nickel, Manganese, Cobalt, Oxidation, Chemical precipitation, Chemical treatment, Ethylene diamine tetraacetic acid.

An examination has been conducted of the effectiveness of homogeneous oxidation catalysis of metal organic complexes, notably the carboxylate salts of nickel and copper, to facilitate metal recovery from industrial waste effluents. Metal finishing industry electroplating solutions contain various organic complexes such as nickel with citric acid and copper with ethylene diamine tetraacetic acid

(EDTA). The objective of this study is to use mild aeration oxidation of the organometallic complexes possible in the presence of an oxidation agent like H2O2, which would not add any additional solids to the treated aqueous effluents. Efficient oxidation destruction of the organic component of the organometallic complex would facilitate metal separation for either disposal or recovery. It has been known for some time that metal organic complexes such as the carboxylate salts of Co, Cu, Ni, Mn, etc. are effective homogeneous oxidation catalysts. This study determines whether homogeneous oxidation catalysis under mild conditions (temperatures < 100 C) of the organometallic complexes, nickel citrate or copper EDTA, would produce efficient self destruction by auto catalysis making the nickel or copper readily available for separation by the common routes of electrodeposition, precipitation or adsorption/ion-exchange. Synthetic solutions of cobalt and nickel with citric acid and of copper with EDTA and a waste solution of a commercial electroless plating solution were evaluated by bench scale experimentation. Oxalate separations had high recoveries. 95-99% were obtained for the solutions with cobalt and nickel citrates and copper-EDTA. A promising high recovery of 99.7% was obtained also with the industrial nickel electroless plating waste. The cobalt and nickel citrates and the copper-EDTA solutions demonstrated efficient oxalate separations without prior oxidation. Oxalate precipitation following the oxidation stage is more efficient than ion exchange with Amberlite XRC 718 in nickel recovery and production of a low residual metal concentration for the electroless nickel waste. (See also W89-10858) (Lantz-PTT)
W89-10933

ELECTROPLATING/METAL FINISHING WASTEWATER TREATMENT: PRACTICAL DESIGN GUIDELINES,
Burns and McDonnell, Kansas City, MO.
R. D. Johnannes, G. J. Humpal, W. V. Schmidt, and R. O. Hoffland.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 727-737, 12 fig, 14 ref.

Descriptors: *Electroplating, *Metal-finishing wastes, *Wastewater treatment, Design standards.

In the field of consulting engineering, the constant pressure to perform the design function at a cost less than the competition often prevents the designer from conducting research prior to being driven to arrive at a conclusion. As applied to the area of treating metal-finishing wastes, it is the purpose of this study to: (1) identify and outline the procedures the designer may apply in the orderly production of the process flow sheet or the Piping and Instrument Diagram ; and (2) develop and present a 'CHECKLIST' for use in the achievement of the design effort, particularly as it applies to selecting the treatment processes to be used. The procedure begins with two rounds of questioning to determine the needs of the treatment process. Reactor designs appropriate for cyanide destruction (alkaline chlorination, ozonation, kastone process, Inko process, and electrolytic decomposition) and/or chromium reduction (sulfur dioxide and sodium bisulfite/metabisulfite) are then evaluated, followed by alternative technologies (ferrous sulfate, ferrous sulfide, and electrochemical procedures). (See also W89-10858) (Lantz-PTT)
W89-10934

WASTE MINIMIZATION IN HISTORICAL PERSPECTIVE,
Illinois Hazardous Waste Research and Information Center, Savoy.
For primary bibliographic entry see Field 5G.
W89-10935

POLLUTION CONTROL PROGRAM FOR THE 'TASTE OF CHICAGO' LAKEFRONT FESTIVAL,
Metropolitan Sanitary District of Greater Chicago, IL.
K. J. Kendrick, A. G. Giedraitis, C. Lue-Hing, and A. J. Sherman.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 751-756, 2 fig.

Descriptors: *Recreation, *Cleanup operations, *Chicago, *Water pollution control, *Lake Michigan, Sanitary wastewater, Water pollution treatment, Public participation, Public waters.

The largest of all the lakefront festivals in Chicago, is the 'Taste of Chicago'. With more than a million people in Grant Park and thousands more on Lake Michigan, the task of controlling pollution to the lake is a formidable and necessary one. The Metropolitan Sanitary District of Chicago has been sampling Lake Michigan for general chemistry: fats, oils, and greases; and fecal coliform since 1981. Operation Lake Watch was established as a routine program for monitoring the water quality of Lake Michigan. This program is pursued year-round except during extreme weather conditions when ice blockages prevent access of pollution control boats to Lake Michigan. Water samples are taken during and after every backflow to Lake Michigan and during Chicago's lakefront festivals. In 1986, a total of 378 samples were obtained and analyzed. In addition, 168 samples were collected in the waters around Navy Pier and Olive Park during the lakefront festivals and 126 samples were obtained from Monroe Harbor during the Taste of Chicago festival. In 1987, 557 samples were obtained under the Operation Lake Watch program and an additional 96 samples were collected in Monroe Harbor during the Taste of Chicago festival. Sampling results indicate that problems and difficulties were directly proportional to the size of the patron population. As the crowd grew, so did the litter. Sample analysis began to indicate the presence of ever-increasing concentrations of contaminants within the storm system and management was asked to conduct daily pumping at key manholes. The established program provided in post-festival site remediation involves multiple street sweepings along with the steam cleaning of those areas most heavily stained by grease and ground-in food waste. The Department of Sewers vacuums out each curb drain and then doses each with one gallon of household grade sodium hypochlorite, prior to flushing each drain with 200 to 500 gallons of water. The disinfected water continues to be pumped to the sanitary sewer during this procedure. The bulkheads are removed only after sewer analysis indicates an acceptable condition. (See also W89-10858) (Lantz-PTT)
W89-10936

IMPROVEMENTS TO A SEPTAGE REGULATION PROGRAM FOR A MAJOR MIDWESTERN CITY,
Montgomery (James M.) Consulting Engineers, Inc., Los Angeles, CA.
For primary bibliographic entry see Field 5G.
W89-10937

CENTRALIZED TREATMENT OF NONHAZARDOUS WASTES: AN ALTERNATIVE MEANS OF LIQUID WASTE DISPOSAL,
Los Angeles County Sanitation Districts, Whittier, CA.
M. W. Miller, M. P. Lo, S. S. Wienke, and J. G. Kremer.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 769-776, 4 fig, 8 tab, 1 ref.

Descriptors: *Wastewater treatment, *Waste disposal, *Liquid wastes, Grease, Industrial wastewater, Pretreatment of wastewater, Oil, Centralized treatment.

Sewerage agencies like the Sanitation Districts of Los Angeles County will continue to require a minimum of gravity separation pretreatment facilities for industrial dischargers. These gravity separators (interceptors, sumps or traps) produce quantities of grit-sediments and oil and grease materials that are either settled or floated in the pretreatment devices. The majority of these residue materials can be classified as nonhazardous wastes. A company within the Sanitation Districts of Los Angeles which previously handled wastes from restaurant grease traps recently expended its operation to be a centralized waste treatment facility for nonhazardous wastes. This company has installed improved pretreatment facilities to treat animal and vegetable oils and greases as well as mineral-based oils and greases with associated sediments. The treatment process essentially removes sediments and oils and greases from the water and produces a clarified wastewater suitable for sewer disposal. The vegetable and animal oils and greases are recycled as an animal feed additive. The sediments are dewatered in a plate and frame filter, and the dry cake transported to a landfill for final disposal. As landfill disposal of liquid waste becomes increasingly restricted, increasing numbers of nonhazardous centralized waste treatment facilities will be required. (See also W89-10858) (Lantz-PTT)
W89-10938

PRETREATMENT LIMITS FOR FATS, OIL AND GREASE,
Howard, Needles, Tammen, and Bergendoff, Milwaukee, WI.
P. V. Cavagnaro, and K. E. Kaszubowski.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 777-789, 6 fig, 5 tab, 38 ref.

Descriptors: *Pretreatment of waste, *Wastewater treatment, *Grease, *Oil, *Pollutant identification, Biological wastewater treatment, Biological treatment, Regulations, Biochemical oxygen demand, Wastewater facilities.

Visible forms of oil and grease account for only a portion of the total oil and grease in wastewater, the rest is in the form of colloidal or emulsified material and composed primarily of food oil. A variety of operational and environmental problems have been directly attributed to the presence of flammable, explosive and viscous oil and grease in wastewater, with the result that discharge of these substances to sewerage facilities has been banned. The analytical procedure used to measure oil and grease is not specific to a single element or compound, but rather detects a group of substances that are soluble in Freon. Publicly operated treatment works (POTWs) should receive and treat compatible wastes. Federal and professional guidelines recognize the ability of POTWs to treat emulsified food oils. The results of bench and full scale tests have demonstrated the ability of biological treatment systems used by POTWs to treat emulsified food oils. A review of POTW ordinances indicates that 100 mg/L is a common discharge limit for oil and grease. The ordinances are usually not consistent with respect to the substance regulated in that some limits apply to mineral oil while others apply to total oil and grease content. The biochemical oxygen demand (BOD) rate constant of food oils is greater than for domestic wastewater. Given the demonstrated biodegradability of food oil and grease materials the BOD test will measure the amount of oxygen required for treatment and removal. Associated costs can be recovered by surcharges to the appropriate user. (See also W89-10858) (Lantz-PTT)
W89-10939

APPLICATIONS OF BIOTECHNOLOGY,
Versar, Inc., Springfield, VA.
R. P. Ouellette, and P. N. Cheremisinoff.
Technomic Publishing Co., Inc., Lancaster, PA. 1985. 247 p.

Descriptors: *Biotechnology, *Wastewater treatment, Biodegradation, Nitrification, Waste recovery, Desulfurization.

This book seeks to identify both the present and future of biotechnology by discussing recent developments as well as extensive reference data and bibliographies for further research. The book is divided into twelve sections: perspectives, the marketplace, 'diseases' (problems) of biotechnology, defense, food and agriculture, chemicals, energy,

environmental protection, leaching of metals, separation/concentration/purification/products recovery, and computers. The chapter on 'biotechnology and environmental protection' discusses applications of biotechnology to wastewater treatment, nitrification, biodegradation, desulfurization, and metal concentration and removal. (See also W89-10960) (Lantz-PTT)
W89-10962

MICHIGAN DIOXIN STUDIES: DOW CHEMICAL WASTEWATER CHARACTERIZATION STUDY, TITTABAWASSEE RIVER SEDIMENTS AND NATIVE FISH,
Environmental Protection Agency, Westlake, OH. Environmental Services Div.
G. A. Amendola, and D. R. Barna.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-249537. Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA-905/4-88-003, June 1986. 118p, 21 fig, 43 tab, 34 ref, 5 append.

Descriptors: *Michigan *Wastewater analysis, *Wastewater treatment, *Sediment contamination, *Fish, *Fate of pollutants, *Dioxins, Tittabawassee River, Organic compounds, Bioaccumulation, Pollution load.

Results of U.S. EPA's study of dioxins and other toxic pollutants at the Dow Chemical-Midland Plant, and summaries of prior EPA and Michigan Department of Natural Resources studies at the same Dow facility, conducted during the period 1978 to 1985, are reported. These studies included research conducted on Tittabawassee River native fish and sediments. An overview is presented of the Clean Water Act requirements for National Pollutant Discharge Elimination System (NPDES) permit conditions for best available technology, as they pertain to the Dow plant. Major findings include: (1) confirmation of the discharge of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD or dioxin) from Dow Chemical to the Tittabawassee River; (2) bioaccumulation of 2378-TCDD in caged fish and native fish; (3) the estimated annual discharge loading of 2378-TCDD from Dow Chemical to the Tittabawassee River is 0.00012 kg. Current discharge levels have consistently been < 10 parts/quadrillion, the interim discharge limit established by the Michigan Water Resources Commission and approved by EPA. (Author's abstract)
W89-10993

ALTERNATE METHODS FOR DISPOSAL OF NITROCELLULOSE FINES,
Brown (John A.) Associates, Inc., Berkeley Heights, NJ.
For primary bibliographic entry see Field 5E.
W89-10996

EVALUATION OF TECHNOLOGIES FOR TREATING AQUEOUS METAL/CYANIDE BEARING HAZARDOUS WASTE (F007),
Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
D. W. Grosse, S. O. Hassan, M. P. Vitello, and M. K. Koczwara.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-249842. Price codes: A03 in paper copy, A01 in microfiche. Report No. EOA/600/D-88/195, August 1988. 14p, 77 fig, 9 tab, 3 ref. EPA Contract 68-03-4038.

Descriptors: *Liquid wastes, *Cyanide, *Hazardous wastes, *Waste disposal, Landfills, Chlorination, Chemical treatment, Chemical precipitation, Filtration, Anion exchange, Cation exchange, Wastewater treatment.

As a result of recent developments in the area of hazardous waste management, the U.S. EPA is evaluating the performance of various technologies for the treatment and/or destruction of certain wastes that are presently being disposed of in landfills and surface impoundments. As a part of this program testing is being conducted on existing treatment technologies that are applicable to metal and cyanide bearing hazardous wastes. The following unit processes were evaluated: alkaline chlorination, precipitation, filtration, anion exchange, and cation exchange. Results of these studies are presented. Two-stage alkaline chlorination coupled with anion exchange was able to polish a cyanide-bearing electroplating wastewater (F007) to the accepted discharge level for cyanide (< 1 parts per million (ppm) of total cyanide). Cation exchange polishing proved to be effective in removing residual metal species from the lime precipitation effluent (< 0.4 ppm for each metal). Examination of several process configurations utilizing alkaline chlorination and ion exchange determined that it was not possible to completely separate cyanide/cyanide complexes from metals in sludges produced in the treatment process. (Lantz-PTT)
W89-11006

WASTEWATER CHARACTERIZATION AND HAZARDOUS WASTE SURVEY, REESE AFB TX,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5B.
W89-11012

5E. Ultimate Disposal Of Wastes

NUTRIENT REMOVAL FROM SECONDARY EFFLUENT BY FILAMENTOUS ALGAE,
Osaka Univ., Suita (Japan). Faculty of Engineering.
For primary bibliographic entry see Field 5D.
W89-10552

OPTIMIZATION MODELS FOR WASTEWATER REUSE IN IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Afshar, and M. A. Marino.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 185-202, April 1989. 6 fig, 2 tab, 33 ref. Agricultural Research Service cooperative agreement 4350-H.

Descriptors: *Wastewater irrigation, *Irrigation design, *Model studies, *Irrigation, *Water reuse, Mathematical models, Land use, Optimization, Runoff, Resource allocation, Water policy, Wastewater renovation, Linear programming, Model testing, California, Future planning.

Mathematical models are formulated to develop management guidelines for an integrated wastewater reuse plan involving the use of reclaimed wastewater to irrigate summer crops. A linear-programming allocation model is used to allocate the available land area and wastewater to different crops. Information provided by the allocation model is used in a pipeline model to determine the optimal diameter of the distribution system. Statistical properties of natural runoff in conjunction with the generated wastewater are used to determine the optimal design and operational parameters of the storage facility (reservoir). The latter is determined by a chance-constrained linear-programming (CCLP) model that minimizes the required capacity and provides information on the reliability of the system or its failure. Reliability of the CCLP model is examined by means of a simulation model. The models are applied to three cities in California and the results are discussed. Although a reasonable probability distribution could be assigned to most of the uncertain parameters (natural streamflow, crop yields and prices), such measures are very difficult to assign to the wastewater expected in the future. The area-allocation model, for all combinations of available water and feasible land area, furnishes the planner with the minimum and maximum possible net benefit that could be expected. Even though the highest level of feasible land area for a given amount of water often results in the highest net return, it is not necessarily the best policy. With the approach outlined and used for the distribution system's optimization, not only could a substantial amount be saved, but a better allocation of the available resource (water) would be achieved. (Miller-PTT)
W89-10556

EFFICIENT ELIMINATION OF ORGANIC LIQUID WASTES: WET AIR OXIDATION,
Institut National des Sciences Appliquees, Toulouse (France). Dept. 'Genie des Procedes Industriels'.
For primary bibliographic entry see Field 5D.
W89-10579

CHARACTERIZATION OF MSW INCINERATOR ASH,
Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
A. Bagchi, and D. Sopcich.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 447-452, April 1989. 1 fig, 3 tab, 4 ref.

Descriptors: *Waste disposal, *Ash, *Toxicity, *Incineration, *Municipal wastes, *Solid wastes, *Hazardous materials, Waste identification, Chemical composition, Chemical analysis, Physical properties, Chemical properties, Sludge lagoons, Sludge, Metals, Wisconsin, Waste management, Pollutant identification, Leachates, Groundwater pollution, Fluidized bed process.

While incineration of municipal solid waste (MSW) is a feasible alternative for managing waste, incinerator ash in not necessarily a chemically inert material. The ash may contain leachable metals and salts that may adversely impact groundwater quality. A test program was utilized to characterize incinerator ash of the Sheboygan, Wisconsin incinerator. Refuse is burned in a fluidized bed furnace, and bottom ash is wet scrubbed and discharged into a settling lagoon. Sludge dredged from the lagoon is disposed of in a landfill owned by the city. Bottom ash and lagoon sludge samples were collected and physically and chemically tested. Bulk chemical analysis, water leach tests, and EP toxicity tests were performed. Detailed chemical characterization indicates that incinerator ash may be classified as hazardous and does contain water leachable constituents that may impact groundwater. (VerNooy-PTT)
W89-10583

ASSESSMENT OF SLUDGE REGULATION ASSUMPTIONS,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 6E.
W89-10639

FRAMEWORK FOR ANALYSIS,
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
For primary bibliographic entry see Field 5G.
W89-10640

MANAGEMENT OF OIL AND GAS PRODUCTION BRINES IN THE ALLEGHENY BASIN,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5G.
W89-10642

APPLICATION OF NATIONAL ENVIRONMENTAL REGULATORY PROGRAMS TO THE APPALACHIAN OIL AND GAS INDUSTRY,
Robinson and McElwee, Charleston, WV.
For primary bibliographic entry see Field 6E.
W89-10643

MANAGEMENT OF OIL AND GAS BRINES–PENNSYLVANIA'S REGULATORY PROGRAM,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Oil and Gas Management.
J. E. Erb.
Northeastern Environmental Science NOESDE, Vol. 7, No. 2, p 121-123, 1988. 1 ref.

Descriptors: *Waste management, *Regulations, *Oil wells, *Gas wells, *Brine disposal, *Pennsylvania, Discharge permits, Toxicity, Environmental policy, Environmental protection.

Since 1983, the Pennsylvania Department of Environmental Resources (DER) has been expanding its regulatory program for the control and disposal of brines from oil and gas wells. Within the DER, the Bureau of Oil and Gas Management (Bureau) acts as a focal point between the agency and the industry. The Bureau has developed a manual to guide oil and gas operators through the regulatory requirements for brine disposal. In addition, the Bureau began issuing permits for discharges of treated brines to surface streams, initiated a study of toxic compounds in brines, and conducted aggressive field activities to eliminate brine discharges to certain high priority streams. These activities have been complemented by a statewide brine discharge inventory developed by the U.S. EPA and by other state and industry initiatives to evaluate various brine disposal methods. (Author's abstract)
W89-10644

DIFFUSIVE CONTAMINANT TRANSPORT IN NATURAL CLAY: A FIELD EXAMPLE AND IMPLICATIONS FOR CLAY-LINED WASTE DISPOSAL SITES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W89-10657

INVESTIGATION OF FAILURE MECHANISMS AND MIGRATION OF ORGANIC CHEMICALS AT WILSONVILLE, ILLINOIS,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5B.
W89-10680

WASTE MANAGEMENT: A LOOK TO THE FUTURE,
Environmental Protection Agency, Washington, DC. Office of Solid Waste and Emergency Response.
J. W. Porter.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 600-604, May 1989.

Descriptors: *Waste management, *Municipal wastes, *Industrial wastes, *Environmental policy, *Legislation, *Regulations, Hazardous materials, Pollution control, Water quality, Future planning, Management planning, Water pollution sources, Water management, Environmental protection, Interagency cooperation, Resource allocation, Waste minimization, Solid wastes.

The past dozen years have seen a special effort to develop effective approaches for the management of both solid and hazardous wastes. Water quality laws have included the Federal Water Pollution Control Act of 1972, the Resource Conservation and Recovery Act (RCRA) of 1976, the Superfund program of 1980, the Hazardous and Solid Waste Amendments passed in 1984, and the Water Quality Act of 1987 which amended the Clean Water Act. However, these regulations seem inadequate as we move beyond conventional point source pollution problems and solutions. Environmental protection is more complex because pollution across environmental media will have to be addressed. The EPA needs to focus resources on the worst problems. The new water and waste management responsibilities come at a time when federal resources are constrained. Given this situation and the need to prevent regulatory requirements conflicts, the EPA is compelled to look creatively at pollution problems. Looking to the future, the EPA will better understand and address the cross-media effects of the pollution control actions taken under separate statutes, so that actions taken under one statute don't create a problem under another. There will be an increased focus on the generation and disposal of solid waste, including municipal garbage. It is expected that Congress will adopt some amendments to RCRA which will pertain to solid waste as well as technical revisions addressing hazardous waste. EPA will emphasize the need to reduce the generation of wastes. Its goal for the immediate future is to provide necessary information and technical assistance to industry, states, and the general public to help further waste minimization goals. (Sand-PTT)
W89-10693

QUANTITATIVE ANALYSIS OF SOLUBILIZED METHANE IN REFUSE LEACHATE,
University of Strathclyde, Glasgow (Scotland). Dept. of Bioscience and Biotechnology.
For primary bibliographic entry see Field 5A.
W89-10703

TREATMENT OF LANDFILL LEACHATE BY SPRAY IRRIGATION--AN OVERVIEW OF RESEARCH RESULTS FROM ONTARIO, CANADA: I. SITE HYDROLOGY,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5D.
W89-10730

TREATMENT OF LANDFILL LEACHATE BY SPRAY IRRIGATION--AN OVERVIEW OF RESEARCH RESULTS FROM ONTARIO, CANADA: II. SOIL QUALITY FOR LEACHATE DISPOSAL,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5D.
W89-10731

ELEMENT COMPOSITION OF MUNICIPAL REFUSE ASHES AND THEIR AQUEOUS EXTRACTS FROM 18 INCINERATORS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Toxic Chemicals Lab.
For primary bibliographic entry see Field 5B.
W89-10733

COMPRESSIVE STRENGTH OF CEMENT CONTAINING ASH FROM MUNICIPAL REFUSE OR SEWAGE SLUDGE INCINERATORS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Toxic Chemicals Lab.
D. J. Lisk.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 42, No. 4, p 540-543, April 1989. 2 tab, 7 ref.

Descriptors: *Waste disposal, *Ash, *Cements, Sludge, Municipal wastes, Performance evaluation, Standards, Alkalinity, Neutralization, Acid rain.

The feasibility of incorporation of municipal refuse or sewage sludge ashes in hydraulic cement mortars was examined and the compressive strength of the resulting cements was tested (American Society for Testing and Materials Method C-109). Two sewage sludge ashes and six refuse ashes from municipal incinerators in eight cities were used. Three ashes met the specifications for type N masonry cement (52.5 kg/sq cm), two ashes met the specifications for type S (126 kg/sq cm), and three ashes met the standards for type M (175 kg/sq cm). A curing time of 28 days before testing was used. In addition to providing a disposal method for ash, the incorporation of toxic metals and toxic organics in immobilized form in a material suitable for construction or disposal. The reserve alkalinity of most refuse ashes has been estimated to be sufficient to neutralize the effects of acid rain leaching for many years, which could improve the durability of cement used for exterior construction. (Rochester-PTT)
W89-10734

ORIGIN AND MOVEMENT OF GROUNDWATER AND MAJOR IONS IN A THICK DEPOSIT OF CHAMPLAIN SEA CLAY NEAR MONTREAL,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
For primary bibliographic entry see Field 2F.
W89-10749

GEOTECHNICAL INVESTIGATIONS OF DREDGED OVERBURDEN AT THE SYNCRUDE OIL SAND MINE IN NORTHERN ALBERTA, CANADA,
Syncrude Canada Ltd., Edmonton (Alberta).
E. R. F. Lord, and B. A. A. Isaac.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 132-153, February 1989. 18 fig, 18 tab, 22 ref.

Descriptors: * Alberta, *Waste dumps, *Clays, *Oil shale, Waste disposal, Geohydrology, Design criteria, Glacial drift, Hydraulic engineering, Construction methods.

The feasibility of constructing a stable overburden waste dump using hydraulic techniques was investigated at the Syncrude Canada Oil Sand Mine. The overburden at the mine consists of Pleistocene clays and tills overlying a Cretaceous clay shale, which in future years will form the majority of the overburden. The geotechnical investigations of the lump deposits, test results, and conclusions derived from the program are reported here. A field pilot study resulted in a total of 25,000 cu m of overburden being dredged, hydraulically transported in lump form, and deposited in a number of study cells. The geotechnical properties of the deposits were tested in the field and laboratory. The results indicate that the potential exists to hydraulically construct waste dumps with Pleistocene materials. Clearwater Formation clay shale also can be transported in lump form, but the resulting deposit requires containment. (Author's abstract)
W89-10751

MUTAGENICITY OF REFUSE LEACHATE FROM A MUNICIPAL INCINERATOR,
Gifu Pharmaceutical Univ. (Japan). Dept. of Environmental Hygiene.
For primary bibliographic entry see Field 5C.
W89-10799

DOWN ON THE FARM,
Fort Collins, CO.
S. Putnam, C. Houck, and W. T. Gallier.
Civil Engineering CEWRA9, Vol. 59, No. 3, p 60-62, March 1989.

Descriptors: *Sludge disposal, *Fertilizers, *Fort Collins, Colorado, *Composting, Sludge utilization, Corn, Wheat, Crop production, Sludge cake, Injection, Monitoring, Nitrogen removal, Cost analysis.

Fort Collins, CO disposes of its wastewater sludge by applying it to a 320-acre farm owned by the community as a corn and wheat fertilizer. With a sludge production of up to 300,000 gpd, a variety of application and treatment procedures is required. Sludge that arrives on flatbed trucks as cakes is spread over the ground surface. Other sludge arrives as a liquid, pumped through a new pipeline to the farm, and is injected into the ground. The farm also has a large composting facility where sludge is turned into a marketable product. The ability to control the forms of nitrogen at the treatment plant allows operators to produce a variety of fertilizers. Nitrogen content can be manipulated by adjusting the degree of thickening or dewatering. EPA pathogen requirements are met by two sludge handling processes. Anaerobic digestion at the plant produces sludges suitable for agricultural use where people are not in direct contact with the sludge. The second handling process is composting on the farm followed by a one-year storage period. These sludges are suitable for bagged fertilizers and use in urban areas. After application at the farm, the soil and groundwater at the farm are monitored. (Doria-PTT)
W89-10816

CHALLENGE OF YUCCA MOUNTAIN,
Thompson (H. Platt) Engineering Co., Inc., Houston, TX.

J. F. Thompson, and S. Frishman.
Civil Engineering CEWRA9, Vol. 59, No. 4, p 44-46, April 1989.

Descriptors: *Radioactive waste disposal, *Underground waste disposal, *Yucca Mountain, *Nevada, *Waste disposal, Technology, Hydrology, Boreholes, Model studies, Model testing, Aeration zone, Geologic fractures, Volcanoes, Construction.

The proposed disposal of high-level nuclear waste in an underground repository at Yucca Mountain, NV presents the geological sciences with an unprecedented challenge: predicting geologic and hydraulic events at the site for 10,000 years to come. Current plans are to store the nuclear waste, in solid form, in long cylindrical canisters placed in boreholes within the drifts of the underground repository. Because Nuclear Regulatory Commission regulations require the waste canisters have a containment life of 300-1,000 years while the repository itself is expected to last 10,000 years, the natural geologic setting of the repository must necessarily serve as the primary means of waste isolation. Concerns associated with potential fluid and gas migration deep within Yucca Mountain arise, in part, from the site's location in the Great Basin, known for its recurrent faulting and volcanism. Given the complexities of the project, the need to rely on models of rock-mass response influenced by construction and testing disturbance is of great concern. Not only are the existing models viewed by many to be inadequate for repository performance prediction, but the question remains regarding the validity of the data needed for the verification of the models that will be collected from the proposed tests and experiments. (Doria-PTT)
W89-10818

DEVELOPING A METHODOLOGY FOR IN SITU MEASUREMENTS OF LOW PERMEABILITY SUITABLE FOR HAZARDOUS-WASTE LANDFILL,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
M. Barres, G. Brossier, and M. Sauter.
Environmental Geology and Water Sciences EGWSEI, Vol. 13, No. 1, p 29-31, January/February 1989. 2 fig, 1 tab, 5 ref.

Descriptors: *Hazardous materials, *Permeability, *Landfills, *Measuring instruments, *Industrial wastes, Land disposal, Infiltration rate, Electrical equipment, Viscosity, Temperature, Wells, Injection, Clays, In situ tests.

Land disposal or dumping of hazardous wastes poses serious environmental and health hazards: soil and water pollution, gaseous release, and various kinds of contamination. In order to evaluate sites for hazardous-waste landfill, two methods were developed for in situ measurements of very low permeability, equal to or less than 10 to the minus 9th power m/s. Both methods need only light equipment and the tests are simple to perform. The first method is the double-ring method with inductive transducer. The sensitivity of this method was increased by measuring the infiltration rate in the inner ring with a float, whose displacement is followed by an inductive transducer. Data are corrected for the influence of water and metal dilation, and for change of viscosity with temperature. The accuracy of this method allows measurement of vertical permeability between 0.00005 and 10 to the minus 9th power m/s. The second method is the pulse-test method. In this method, a well is suddenly pressurized by injecting water, followed by sealing. The decline of pressure with time is recorded and the data are used to calculate the permeability in the test interval. The equipment is specially designed for surface investigations in clay formations with values of permeability in the range of 10 to the minus 7th power m/s to 10 to the minus 11th power m/s. (Author's abstract)
W89-10840

PROCEEDINGS OF THE 43RD INDUSTRIAL WASTE CONFERENCE.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10858

DESIGN CONSIDERATIONS FOR A WISCONSIN PAPER MILL LANDFILL,
Becher-Hoppe Engineers, Inc., Wausau, WI.
E. L. Fisher, and G. T. Griffith.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 123-136, 11 fig, 6 tab, 3 ref.

Descriptors: *Landfills, *Management planning, *Design standards, *Waste disposal, *Pulp wastes, Wisconsin, Pulp and paper industry, Liners, Groundwater pollution, Environmental effects, Leachates.

Several years and thousands of hours have been dedicated to the task of developing and obtaining approval for the new 3,000,000 cu yd landfill for the Nekoosa Packaging Corporation in Tomahawk, Wisconsin. This labor was rewarded in 1987 when the 55-acre site was approved by the Wisconsin Department of Natural Resources and the first 5-acre phase was constructed. This case history presents the primary choices for this site, which were selected because of: (1) its convenience to the waste source, the 1200-ton/day pulp and paper mill; and (2) the absence of significant impact from the existing 30-acre natural attenuation landfill located adjacent to the new site. In developing this landfill, the following four factors were particularly important: spatial constraints--< 80 acres of company-owned land were available for the landfill; landfill liner material--the Wisconsin Solid Waste Regulations require major landfills such as this site to provide an impervious liner, preferably the use of a high quality, recompacted, natural clay liner; separation from groundwater--the Wisconsin Department of Natural Resources (WisDNR) personnel require a minimum of five to ten ft of unsaturated soil below the base of the landfill liner and above the groundwater; and, private wells--a total of 19 private wells and 15 mill wells were located within 1200 ft of the new landfill. WisDNR required an alternate water supply be provided for these wells. Two options were available to the mill to extend the City of Tomahawk water main across the Wisconsin River to supply the homes, or to install a deep well outside the 1200 ft limit and operate a private water supply. Extending the City water main was selected. Special constraints (such as highways, surface water, wetlands, and old landfills), landfills, groundwater quality, groundwater control, landfill base design, leachate transfer, final cover, environmental monitoring, and closure and long-term care, are further design considerations discussed in this paper. (See also W89-10858) (Lantz-PTT)
W89-10875

LONG-TERM COMPATIBILITY STUDY OF A TREATED BENTONITE/SOIL LINER WITH A HEAVY METAL SLUDGE,
American Colloid Co., Arlington Heights, IL. Environmental Products Div.
For primary bibliographic entry see Field 5B.
W89-10876

FIELD MEASUREMENT OF LANDFILL CLAY LINER PERMEABILITY,
Peoria Disposal Co., IL.
R. Edwards, and D. G. Yacko.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 141-146, 7 fig, 1 tab.

Descriptors: *Clays, *Liners, *Landfills, *Field tests, *Water pollution prevention, Design standards, Soil properties, Permeability, Illinois.

A test fill clay liner was constructed by Peoria Disposal Company (PDC) in the summer of 1987. Soil materials and construction equipment practices established during construction of the test fill resulted in a fill having the desired soil liner performance characteristics. The computed permeability coefficients of the constructed test fill liner as determined through both laboratory testing of undisturbed samples of the in-place liner fill, and field testing of a large portion of the test fill liner, are in relative agreement, and indicate a constructed fill having a permeability on the order of 1 nano-cm/sec, which is two orders of magnitude less than the maximum 1 times 10 to the -7th cm/sec permeability that the US EPA allows. By following the same construction practices during landfill construction using the same compaction equipment as used for test fill liner construction, the same low liner permeability could be indirectly assured by carefully controlling compaction density and moisture content. The in-place landfill liner permeability was verified through a comprehensive quality assurance program of sampling and laboratory permeability testing. (See also W89-10858) (Lantz-PTT)
W89-10877

CHARACTERIZATION AND EVALUATION OF ENVIRONMENTAL HAZARDS IN A LARGE METROPOLITAN LANDFILL,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5A.
W89-10878

EFFECTS OF MASS TRANSFER ON LANDFILL STABILIZATION RATES,
Tufts Univ., Medford, MA. Center for Environmental Management.
J. J. Noble, T. Nunez-McNally, and B. Tansel.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 153-159, 1 fig, 4 tab, 19 ref. EPA Contract CR 813481-01-1.

Descriptors: *Landfills, *Mass transfer, *Waste disposal, *Solid waste disposal, *Degradation, Lignocellulose, Porosity, Hydrolysis, Diffusion, Methane.

Rates of municipal solid waste (MSW) decomposition and attendant sanitary landfill stabilization are often seen to be quite slow. Some wastes may be recovered essentially intact after 20-30 years. Three important reasons that landfills decompose so slowly are: (1) lack of sufficient moisture for optimal enzyme activity; (2) imbalance between the production of organic acids by acid-forming bacteria and the conversion of these acids into methane by methanogenic bacteria; and (3) mass transfer limitations in the landfill environment. The readily biodegradable material might comprise 5% of the MSW and convert completely to methane in 2 to 3 years. The next phase of degradation is when the more recalcitrant and insoluble lignocellulosic material become the most biodegradable remaining substrate. In this latter period, cellulose hydrolysis then becomes rate limiting with the resulting 15-50 year degradation time scales. Lignocellulosic waste (paper, cotton, etc.), the dominant component of domestic MSW, has a complex micro/macroporous pore structure. The micropores contribute the majority of the surface area but are probably excluded from biological activity because their pore diameters (about 200 angstroms) are much smaller than typical bacterial sizes (0.2 to 2 microns). The micropores are probably very important in moisture redistribution. Calculations presented here for order-of-magnitude estimates of aqueous diffusion (macropore and bulk) of typical cellulitic bacteria and enzymes strongly suggest that the long-term rate limiting step in landfills with low moisture content is the mass transfer controlled heterogeneous hydrolysis of the lignocellulosic components of the MSW. In particular, depending on diffusion path length, the estimated diffusion times in stagnant moisture can vary between days and hundreds of years. It is difficult to envision another physical mechanism which will so readily explain 15-50 yr landfill stabilization times. (See also W89-10858) (Lantz-PTT)
W89-10879

PHYSICAL AND CHEMICAL CHARACTERISTICS OF UNSATURATED PORE WATER AND LEACHATE AT A DRY FLY ASH DISPOSAL SITE,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-10880

EVALUATION OF LEACHATE MONITORING DATA FROM CO-DISPOSAL, HAZARDOUS, AND SANITARY WASTE DISPOSAL FACILITIES,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-10881

PRELIMINARY ASSESSMENT OF A MICROFILTRATION/REVERSE OSMOSIS PROCESS FOR THE TREATMENT OF LANDFILL LEACHATE,
Zenon Environmental, Inc., Burlington (Ontario).
For primary bibliographic entry see Field 5D.
W89-10882

COMPARISON OF GLUCOSE AND METHANOL AS CARBON SOURCES FOR DENITRIFICATION IN BIOLOGICAL TREATMENT OF LEACHATE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10883

STORMWATER RUNOFF CONTROL: AN OPERATIONAL DIFFICULTY FOR ABOVE-GROUND INDUSTRIAL WASTE LANDFILL,
AWARE, Inc., Nashville, TN.
For primary bibliographic entry see Field 5G.
W89-10884

CONTROL OF METHANE FROM MUNICIPAL SOLID WASTE LANDFILLS BY INJECTION OF LIME AND FLYASH,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W89-10885

WASTE MINIMIZATION IN HISTORICAL PERSPECTIVE,
Illinois Hazardous Waste Research and Information Center, Savoy.
For primary bibliographic entry see Field 5G.
W89-10935

IMPROVEMENTS TO A SEPTAGE REGULATION PROGRAM FOR A MAJOR MIDWESTERN CITY,
Montgomery (James M.) Consulting Engineers, Inc., Los Angeles, CA.
For primary bibliographic entry see Field 5G.
W89-10937

CENTRALIZED TREATMENT OF NONHAZARDOUS WASTES: AN ALTERNATIVE MEANS OF LIQUID WASTE DISPOSAL,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W89-10938

CONTAMINATED WASTE SITES, PROPERTY AND YOUR HEALTH,
Lappenbusch Environmental Health, Inc., Alexandria, VA.
W. L. Lappenbusch.
Lappenbusch Environmental Health, Inc., Alexandria, Virginia. (1988). 360 p.

Descriptors: *Waste disposal, *Water pollution effects, *Public health, *Pollutant identification, *Waste management, Soil contamination, Drinking water, Air pollution, Decision making, Risk assessment, Toxicity, Legal aspects, Path of pollutants, Water quality standards.

This book addresses the potential health effects and health risks associated with polluted drinking water, ambient water, soil/sediment/sludge, food and air, from contaminated waste deposited on land or in water. It identifies and delineates the exposure media of concern, the types of pollutants of concern, scientific considerations that should be addressed prior to making a risk assessment, types of defensible risk assessments that are available and in the best interest of selected parties, as well as the methodologies used to calculate potential morbidity and mortality. The standards--and guidance-comparison process is delineated, clarified and expanded, so as to provide a useful tool for decision making. It also prioritizes and specifies which numbers should be used for comparison under a variety of circumstances. The two processes for clarifying the risk, namely: 'dose-addition' analysis for non-carcinogens and 'response-addition' for the carcinogens are clearly delineated. Furthermore, the methodologies for modifying the risk from complex mixtures to account for mineral metabolism, target organs and multiple stress (synergism and antagonism) are also expressed. Finally, this book, specifies the acceptable levels of pollutants in drinking water, lakes and streams, soil, food and air. (Lantz-PTT)
W89-10990

ALTERNATE METHODS FOR DISPOSAL OF NITROCELLULOSE FINES,
Brown (John A.) Associates, Inc., Berkeley Heights, NJ.
J. A. Brown, and H. S. Skovronek.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 463. Price codes: A04 in paper copy, A01 in microfiche. Final Technical Report No. AMXTH-TE-TR-85020, July 22, 1985. 50p, 36 ref, append. Department of the Army Contract DAAK11-84-C-0062.

Descriptors: *Chemical wastes, *Waste disposal, *Nitrocellulose, *Wastewater treatment, Waste management, Industrial wastes, Centrifugation, Separation techniques, Filtration, Pyrolysis, Ultrafiltration, Military reservations, Permits.

Current facilities for treatment of nitrocellulose fines-bearing wastewaters at Radford Army Ammunition Plant (RAAP) consist of settling pits, a bank of DeLaval centrifuges and, after mixing with other wastewaters, a final settling lagoon. The centrifuges are not being operated at this writing (spring 1985) because, at current production levels, RAAP is in compliance with their discharge permit without them. However, RAAP would probably not be in compliance at mobilization rates and would certainly not be in compliance if the discharge limits were to be significantly tightened. Accordingly, the U.S. Army Toxic and Hazardous Materials Agency initiated this project to identify and assess alternate, more effective, methods of NC fines minimization, segregation and disposal. There are several 'ready technologies' that appear to be capable of removing NC fines more thoroughly than current RAAP practice does: improved settling pit design probably combined with coagulation similar to that used in the paint and pigment industry; centrifugation; and of course combinations of these. There are also at least 19 'innovative technologies' that might, with development, provide even more effective NC fines removal. These innovative technologies have been assessed and compared; and five of them--sticky filters, ion control, liquid/liquid extraction, cross-linking and laser pyrolysis--are recommended for exploratory development. Two other technologies--ultrafiltration and microfiltration--have seen extensive development in other fields and are recommended for engineering study. This report presents the details of the technology assessment and comparison methodology, along with recommended exploratory development and test plans. (Lantz-PTT)
W89-10996

FLEX: AN EXPERT SYSTEM TO ASSESS FLEXIBLE MEMBRANE LINER MATERIALS,
Environmental Protection Agency, Cincinnati, OH.
R. E. Landreth.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-249578. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/182, August 1988. 11p, 7 tab.

Descriptors: *Computer programs, *Materials engineering, *Waste management, *Liners, *Water pollution prevention, FLEX, Membrane liners, Permselective membranes, Materials testing, Performance evaluation, Chemical properties, Data interpretation, Expert systems, Data collections, Permits, Landfills, Wastewater lagoons, Leachates, Physical properties.

When a landfill or lagoon site is proposed, the U.S. EPA requires the party seeking the permit to submit evidence that the proposed site will not cause damage to the surrounding environment. To protect the soil and groundwater beneath and adjacent to the site, flexible membrane liners (FML) have been determined to meet the Agency's liquids management strategy. Since there are wide variations in the quality of leachates from waste management sites and a wide variety of candidate liners, part of the proposal package must include data that will allow the EPA or state permit reviewer to judge the suitability of the proposed FML material. To demonstrate the chemical resistance of the FML, EPA requires that its Method 9090 be used, as a minimum, to test chemical resistance. In the test, the physical properties of FML specimens that have been immersed in waste/leachate (at 25 C and 50 C) are measured after each of four successive months and compared with the original unexposed FML physical properties. The FLEX (Flexible Liners Expert) system for evaluating chemical resistance data of FMLs, is a computer program whose results are presented in a written textual report generated as the system runs. This report lists problems with the data (too scattered or missing) as well as any values that indicate that the liner may be substandard or incompatible with the immersion medium. Also included in this report are explanations as to why any data are deficient. To test the validity of the FLEX advisory system, five recognized FML experts evaluated sample data sets for three types of FML's--data sets similar to those produced by EPA Method 9090. The comparisons of the FLEX conclusions with those of the experts demonstrates the feasibility and practicality of FLEX. FLEX is able to advise concerning the FML chemical resistance of data submitted as part of a permit application. The system can be characterized as conservative--more stringent in its criteria than were some of the experts. Where FLEX and the experts disagreed, the system more often found the FML not resistant whereas the experts judged the data as being missing or with no indication not resistant. The system is presently useful to guide the permit reviewer and to identify those parts of the permit application where a more in-depth investigation is needed. (Lantz-PTT)
W89-11004

LOCATING AND REPAIRING LEAKS IN LANDFILL/IMPOUNDMENT FLEXIBLE MEMBRANE LINERS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W89-11005

TRANSPORT OF A CONSERVATIVE SOLUTE THROUGH A SHALLOW POND BOTTOM,
California Univ., Berkeley. Dept. of Materials Science and Mineral Engineering.
For primary bibliographic entry see Field 5B.
W89-11007

WASTEWATER CHARACTERIZATION AND HAZARDOUS WASTE SURVEY, REESE AFB TX,
Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.

For primary bibliographic entry see Field 5B.
W89-11012

5F. Water Treatment and Quality Alteration

DIRECT FILTRATION OF CHLORELLA WITH CATIONIC POLYMER,
Geustyn, Forsyth and Joubert, Inc., Pretoria (South Africa).
J. Haarhoff, and J. L. Cleasby.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 348-366, April 1989. 8 fig, 2 tab, 22 ref.

Descriptors: *Water treatment, *Separation techniques, *Filtration, *Filter media, *Chlorella, *Polymers, Organic matter, Chlorophyta, Culturing techniques, Carbon, Cations, Dissolved solids, Turbidity, Flocculation.

The excessive presence of algae in drinking-water supplies has long been known to pose significant operational problems to water-treatment-plant operators. There has been a growing awareness that the growth of algae contributes not only a particulate fraction to the water, but also an equally important fraction of soluble organic carbon. The extracellular organic matter (EOM) released by laboratory algal monocultures of Chlorella was characterized in terms of its molecular weight distribution and its electrical charge concentration, and was found to compare well with the dissolved carbon found in natural algal-rich impoundments. Reaction between EOM and cationic polymer was demonstrated, with concomitant turbidity development. A simple turbidimetric procedure for rapid estimation of the cationic polymer demand exerted by the EOM is proposed. The significance of this EOM demand was demonstrated in a series of direct filtration experiments with algal suspension. When just enough cationic polymer was added to quench the EOM demand, no polymer was available to flocculate the algal cells and cell removal was poor. If more polymer was added, the polymer that remained after reaction with the EOM did cause flocculation of the algal cells with improved removal. On an equal mass basis, a cationic polymer with higher charge density did better than a polymer with lower charge density. The qualitative effects of a prolonged mixing step between polymer addition and filtration were observed. (Author's abstract)
W89-10578

ANALYTICAL APPROACH FOR EVALUATION OF SETTLING COLUMN DATA,
Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-10584

HARMONIC MEAN CONDUCTIVITY IN DECLINING RATE FILTERS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Civil Engineering.
A. M. Saatci.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 462-466, April 1989. 2 fig, 9 ref.

Descriptors: *Water treatment, *Mathematical models, *Filters, *Conductivity, Harmonic mean conductivity, Hydraulic conductivity, Filtration, Design criteria, Declining rate filters, Head loss.

Increasing popularity of declining rate filters (DRF) has started a search for their design in a rational manner. This paper explains a method for the determination of equivalent homogeneous conductivity in deep bed filters. Harmonic mean conductivity is discussed, as well as hydraulic conductivity models. Application of harmonic mean conductivity in declining rate filtration theory predicts lower filtration rates, better filter performance (lower (C/C sub 0 ratios), and higher headlosses when compared with the results based on the average hydraulic conductivity. (VerNooy-PTT)
W89-10585

USE OF DISSOLVED-AIR FLOTATION IN POTABLE WATER TREATMENT IN FINLAND,
J. Heinanen.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 113-123, 1988. 3 fig, 10 tab, 11 ref.

Descriptors: *Flotation, *Water treatment, *Potable water, Flocculation, Clarification, Finland.

Flotation is a very suitable method for treating Finnish surface waters. These are soft and usually clear, but contain humic matter which must be removed before they can be accepted as drinking water. A survey was made of almost all the potable water treatment plants in Finland that use dissolved-air flotation. The first plant was constructed in 1965 and by 1988 they numbered 34. The machinery is delivered according to the turnkey system and the guarantee includes the quality of the treated water. The Finnish plants using dissolved-air flotation are working well and their operational problems are few. An important advantage of the flotation process is its reliability but the belief in the superiority of conventional sedimentation seems to be difficult to eradicate. The other main advantages of flotation are that it is easy to interrupt and start again, that it removes small particles effectively, results in small coagulant residuals and is effective in both winter and summer despite the good treatment results, some criticism of the process can be made. The design parameters are far from ideal and have resulted in unnecessarily high construction costs. (Sand-PTT)
W89-10608

USE OF OZONE AND FLUIDIZED-BED BIOFILTERS FOR INCREASED AMMONIA REMOVAL AND FISH LOADING RATES,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
For primary bibliographic entry see Field 8I.
W89-10626

PESTICIDE RESIDUES IN DRINKING WATER IN THE NORTH COAST REGION OF NEW SOUTH WALES, AUSTRALIA, 1986-87,
New South Wales Dept. of Health, Lidcombe (Australia). Div. of Analytical Labs.
For primary bibliographic entry see Field 5B.
W89-10738

COQUITLAM LAKE WATER TUNNEL UPGRADING--DESIGN AND CONSTRUCTION, A CASE HISTORY,
Stewart-EBA Consulting Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 8A.
W89-10750

PHOTOCATALYTIC OXIDATION OF NITRITE IN WATER TO NITRATE,
Institute of Fundamental Studies, Kandy (Sri Lanka).
For primary bibliographic entry see Field 2K.
W89-10755

MUTAGENICITY AND ALKYLATING ACTIVITY OF THE AQUEOUS CHLORINATION PRODUCTS OF HUMIC ACID AND THEIR MOLECULAR WEIGHT FRACTIONS,
New York Univ. Medical Center, NY. Inst. of Environmental Medicine.
S. C. Agarwal, and J. Neton.
The Science of the Total Environment STENDL, Vol. 79, No. 1, p 69-83, February 1989. 4 fig, 3 tab, 33 ref. EPA Cooperative Agreement No. CR807317, and USPHS Grants ES-00260 and CA-13343.

Descriptors: *Humic acids, *Drinking water, *Chlorination, *Carcinogens, *Water pollution sources, *Water treatment, *Mutagenicity, Organic compounds, Substrates, Water analysis, Chlorinated hydrocarbons, Oxygen, Molecular structure, Organic carbon, Model studies, Ultrafiltration, Halogens, Volatility, Hydrogen ion concentration, Chemical degradation, Hydrolysis.

The practice of chlorination of drinking water produces various compounds suspected of having a potential carcinogenic impact. The increased risk arises from the various compounds that are generated by the action of chlorine on organic precursors, particularly humic substances. Fluka humic acid used as a model substrate in these studies was analyzed for elemental composition and the oxygen-containing functional groups. It was chlorinated at C:Cl molar ratios of 1:1 and 1:0.3 and subsequently separated into molecular weight fractions by ultrafiltration. Theze-dried, chlorinated humic acid and the respective molecular weightions were analyzed for TOC (total organic carbon), TOX (total organicgens), alkylating activity using 4-(p-nitrobenzyl)pyridine andgenicity by the Ames/Salmonella/microsome assay with strains TA-98 and00. Results indicated that predominantly non-volatile, direct-actinggenic and/or alkylating agents were formed during humic acidrination and that these agents were unevenly distributed among theous molecular weight fractions. Formation of mutagenic and alkylatingts were highly dependent upon level of chlorination and total organicon. Higher levels of mutagenic and alkylating activities were producedincreasing concentration of chlorine in the range of 0.4-1.2 chlorinevalents per mole of carbon. However, both these activities in theze-dried, chlorinated humic acid solutions containing the non-volatileshe fresh solutions decreased gradually with increasing pH and storage, apparently due to degradation and hydrolysis of some of theonents. (Author's abstract)
W89-10801

ALUMINIUM, ITS USE AND CONTROL, IN POTABLE WATER,
Laporte Inorganics, Cheshire (England).
A. M. Simpson, W. Hatton, and M. Brockbank.
Environmental Technology Letters ETLEDB, Vol. 9, p 907-916, 1988. 3 fig, 2 tab, 25 ref.

Descriptors: *Aluminum, *Water treatment, *Flocculation, *Potable water, Chemical coagulation, Hydrolysis, Precipitation, Hydrogen ion concentration, Filters, Particulate matter.

It is generally accepted that the addition of aluminum flocculants is an essential step in the treatment of most raw waters for potable purposes. At working pH values precipitation occurs of highly insoluble chemicals, mainly aluminum hydroxide which is removed during the treatment process. However, some low residual level of soluble aluminum remains in the treated water. Case studies show that residual aluminum can be reduced by using more efficient coagulants that hydrolyze and precipitate more effectively and over wider pH ranges. Attention must be given to maintaining filter efficiency and eliminating particulate aluminum breakthrough and also taking care on plants where pH increase is required for distribution which will solubilize aluminum into the network. The mechanism by which the alternative aluminum-based products reduce residual aluminum levels is complex, but increased polymerization, reduced product charge, and significantly less acid product contribute to faster and more efficient precipitation of hydroxide and ultimately improved insolubilization of the aluminum, especially in cold water conditions where reaction rates are much reduced. Besides reducing residual aluminum levels, the poly aluminum chloride coagulants offer improved pH correction, better floc blankets, improved turbidity removal, and excellent operation in cold water. (Author's abstract)
W89-10830

EVALUATION OF METAL CONCENTRATIONS IN BOTTLED WATERS AND THEIR HEALTH SIGNIFICANCE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 5A.
W89-10831

AMMONIA REMOVAL ALLOWS EFFLUENT REUSE AT FISH HATCHERY USING FLUIDIZED BED REACTORS,
Dworshak National Fish Hatchery, Ahsahka, ID.
For primary bibliographic entry see Field 5D.
W89-10908

TOTAL CLOSING OF PAPER MILLS WITH RECLAMATION AND DEINKING INSTALLATIONS,
Krofta Engineering Corp., Lenox, MA.
For primary bibliographic entry see Field 5D.
W89-10928

MICHIGAN WATER WELL GROUTING MANUAL: A GUIDE FOR THE CONTRACTOR,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
For primary bibliographic entry see Field 8A.
W89-10989

RADIUM REMOVAL FOR A SMALL COMMUNITY WATER SUPPLY SYSTEM,
Rocky Mountain Consultants, Inc., Englewood, CO.
K. A. Mangelson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-235551. Price codes: A04 in paper copy, A01 in microfiche. Report No. EPA/600/2-88/039, July 1988. 59p, 18 fig, 24 tab, 17 ref, append. EPA Contract CR-812691-01-0.

Descriptors: *Radium, *Water treatment, *Iron, *Water treatment facilities, *Chemical treatment, Wastewater treatment, Sedimentation, Filtration, Ion exchange, Oxidation.

A radium removal treatment plant was constructed for the small community of Redhill Forest in the central mountains of Colorado. The plant consists of iron removal using oxidation, filtration, and settling; radium and hardness removal using ion exchange; and radium removal from the waste brine using Dow Chemical Company's Radium Selective Complexer (RSC). The raw water comes from deep wells and has naturally occurring radium and iron concentrations of about 30-40 picoCuries/L (pCi/L) and 7-10 mg/L, respectively, and is aerated before entering the main treatment plant to remove radon gas and carbon dioxide. A unique feature of the plant is the process that removes radium from the waste brine. This process removes only radium from the spent ion exchange regeneration water by permanently complexing the radium on the RSC. The RSC is replaced when exhausted and sent to a final disposal site that is acceptable to state regulatory agencies. The overall plant reduces radium from about 35 pCi/L to < 4 pCi/L. The RSC system has consistently removed > 95% of the radium from the spent ion exchange regenerant. The average inflow radium concentration to the RSC was about 1,800 pCi/L and the average effluent was about 9 pCi/L. (Author's abstract)
W89-10994

SIMNET-MICROCOMPUTER MODELLING OF IRRIGATION, WATER SUPPLY AND WATER DISTRIBUTION SYSTEMS,
City Univ., London (England). Thermo-Fluids Engineering Research Center.
For primary bibliographic entry see Field 7C.
W89-11034

OPTIMAL DESIGN OF PIPE NETWORKS: A REVIEW,
Exeter Univ. (England). Dept. of Engineering Science.
G. A. Walters.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 21-31, 1 fig, 28 ref.

Descriptors: *Project planning, *Economic aspects, *Pipelines, *Conveyance structures, *Optimization, *Pipes, *Hydraulic structures, Networks, Reviews, Computer programs, Costs.

Networks of pipes for conveying water form a major part of a country's investment in water resources. While the cost of these networks is high, their design is still performed on a largely intuitive basis. Currently, it is unusual for any systematic comparison of alternative designs with different layouts and pipe sizes to be carried out on a cost basis; however, with the widespread availability of computers, it is now possible to take a much more systematic approach to achieve the best value for money in design. The formal computer-based optimization techniques that have been developed for pipe network design systematically examine a range of schemes involving alternative layouts and/or pipe sizes, the schemes all being of equivalent technical merit but varying in cost. The techniques reviewed are Dynamic, Linear and Nonlinear Programming and heuristic methods. The historical development of these techniques is outlined, with a summary of published work. Future research should delve into the criterion of minimum construction cost in conjunction with reliability of the network and maintenance costs. (See also W89-11033) (Author's abstract)
W89-11035

FUZZY PROGRAMMING APPLICATIONS IN WATER DISTRIBUTION NETWORK DESIGN,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and F. Bouchart.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 33-44, 1 fig, 4 tab, 16 ref.

Descriptors: *Project planning, *Water conveyance, *Water distribution, *Computer programs, *Optimization, *Networks, *Computer models, *Model studies, Hydraulic properties, Flow pattern, Conveyance structures, Fluid mechanics.

The use of linear fuzzy programming in least cost design of water distribution networks is examined. It is shown that use of the fuzzy programming approach overcomes a problem inherent in most optimization models, namely, they completely reject any solution that is very close to but below a certain minimum pressure standard, while accepting any solution that just meets the standard. This problem is overcome in the fuzzy programming approach by the selection, within the model, of a pressure that lies between a desired or preferred value and the value below which the level of service is always completely unsatisfactory. The choice of this intermediate value is made in light of the cost implications (savings) of the choice. The procedure is demonstrated by application to a branch network. Mechanical reliability implications of the reduction in minimum pressure for the sample problem are examined briefly. It appears that fuzzy programming can be applied to looped systems once the problem is overcome of having different flow patterns at the upper and lower bound least cost solution. A method to solve this problem is being investigated. (See also W89-1103) (Freidmann-PTT)
W89-11036

NEW TECHNIQUES IN WINDMILL PUMPS(TECHNIQUES NOUVELLES POUR LE POMPAGE EOLIEN),
Paris-6 Univ. (France). Lab. de Mecanique Experimentale des Fluides.
L. Bchir, M. Ben Amar, and R. Comolet.
In: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 79-90, 13 fig, 1 tab, 13 ref. No English summary.

Descriptors: *Pumps, *Windmills, *Water supply development, *Water distribution, Developing countries, Africa, Solenoid pumps.

Water pumping is one of the serious problems in the developing countries of the African continent. In Mauretania, for example, no more than 16% of the water sources qualify as technically available while the remaining 84% are technically rudimentary. Lack of adequate energy sources is compounding the problem. To solve this difficulty, the exploitation of wind energy in conjunction with a solenoid pump and a Darrieus-type windmill has been proposed. This self-starter pump has the advantage of a simple mechanism which permits a flow containing sand and other impurities. The results of theoretical studies have been confirmed by experimental work using a prototype miniature solenoid pump. The hydraulic characteristics of the pumping mechanism were also investigated both theoretically and experimentally and it was concluded that the proposed windmill-driven pump is well suited for application in the countryside. (See also W89-11033) (Peters-PTT)
W89-11040

MINICOMPUTER DESIGN AND MANAGEMENT OF WATER SUPPLY SYSTEMS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
M. Nouh.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 101-113, 6 tab, 19 ref.

Descriptors: *Computer programs, *Water supply, *Optimization, *Water conveyance, *Cost analysis, Design criteria, Economic aspects, Costs, Pipes, Pipelines, Reservoirs.

A minicomputer program titled Optimal Water Supply System Design (OWSSD) is applicable to either closed loop or open loop networks. It generates a least total costs design of a water supply system of a given configuration. It also can evaluate the effect that design criteria, uncertainty in water supply and demand, and alteration of pipe diameters and roughnesses have on the cost and operation of the system. The total costs considered include the pipe costs, the pumping installation and operating costs, the costs of reservoirs, the labor and maintenance costs, and the treatment costs. (See also W89-11033) (Author's abstract)
W89-11042

5G. Water Quality Control

TREATMENT OF MANGANESE FROM MINING SEEP USING PACKED COLUMNS,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
J. A. Gordon, and J. L. Burr.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 386-394, April 1989. 5 tab, 11 ref.

Descriptors: *Strip mine wastes, *Manganese, *Effluent seepage, *Chemical precipitation, *Mine drainage, *Oxidation, *Water pollution treatment, *Biological oxidation, *Slime, Seepage, Surface drainage, Filter media, Packed columns, Alabama.

A manganese-laden seep from a reclaimed strip-mined area in northern Alabama was successfully treated on a small-scale basis using packed column technology. Manganese concentrations were reduced from about 10 mg/L to below 2 mg/L to meet Alabama discharge standards. The process looks very promising as a new manganese treatment method. The three columns developed during this research used chert, sandstone, and glass marbles as packing material. The columns were either four or six feet tall and hydraulically loaded at about 5.4 cu m/sec per 100,000 sq m. The mass loading with a dissolved manganese concentration of 9 mg/L was about 0.24 mg/min. The pH of the seep water ranged from 5.8 to 6.3. The columns were operated in a submerged, upflowing manner at temperatures between 20 and 30 C. The acclimation of the columns required eight weeks using seed from the Duck River in Tennessee, which has manganese oxidizing slimes on the stream-bed stones. (Author's abstract)
W89-10580

MODELING PHOSPHORUS TRANSPORT IN GRASS BUFFER STRIPS,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5D.
W89-10581

FAUNA STRUCTURE AND WATER QUALITY,
Goeteborg Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-10613

FADING RECOVERY: A CONCEPTUAL MODEL FOR LAKE VESIJARVI MANAGEMENT AND RESEARCH,
Lahti Municipal Lab. (Finland).
For primary bibliographic entry see Field 5C.
W89-10614

FRAMEWORK FOR ANALYSIS,
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
J. W. Walker.
BioCycle BCYCDK, Vol. 30, No. 4, p 71-79, April 1989. 8 tab, 6 ref.

Descriptors: *Standards, *Environmental protection, *Water pollution control, *Regulations, *Sludge disposal, Land disposal, Incineration, National Sewage Sludge Survey, Environmental policy, Risks, Public participation, Wastewater analysis.

A framework for analyzing the EPA Proposed Standards For the Disposal of Sewage Sludge is presented. The new proposed technical sludge regulations establish an initial set of minimum Federal requirements for the final use and disposal of sewage sludge including land application, distribution and marketing, sludge-only landfilling (monofilling), surface disposal (impoundments), and incineration. Although these regulations involved the establishment of a risk-based approach, the proposed regulations raise many scientific, technical and policy issues not addressed in prior federal regulations. Therefore, EPA is conducting a National Sewage Sludge Survey which will provide detailed analysis of sludges and their pollutant contents, gathering data on the movement of certain pollutants into and through the environment, and asking experts from inside and outside the Agency to review the scientific and technical basis of the proposal. EPA is encouraging the active involvement of the public in reviewing the proposed regulations, and a list of contact persons within EPA is provided. Reviewers should balance concern over impacts with concern over the derivation of numerical limits, and provide meaningful comments on the technical validity of the regulations. Areas to be reviewed include: the extent to which pretreatment can result in sludges with lower contents of pollutants, which can in turn serve as a mechanism of compliance with requirements of the regulation; the ability of these risk-based regulations to mesh with the existing best management practice regulations; the reasonableness of the assumptions used in the development of the regulations; and the practicality of obtaining the limits of detection for pollutants requested in the proposed regulation. (White-Reimer-PTT)
W89-10640

MANAGEMENT OF OIL AND GAS PRODUCTION BRINES IN THE ALLEGHENY BASIN,
Pennsylvania State Univ., University Park. School of Forest Resources.
S. B. Jones, and B. A. Waite.
Northeastern Environmental Science NOESDE, Vol. 7, No. 2, p 99-104, 1988. 1 tab, 9 ref.

Descriptors: *Waste management, *Production water, *Water pollution control, *Regulations, *Oil industry, *Gas industry, *Oil pollution, *Gas pollution, *Brine disposal, Surface water, Groundwater, Land disposal, Underground waste disposal, Research priorities.

Oil and gas production brines in the Allegheny Basin have been identified as a source of potential degradation for surface streams and groundwater. State and federal environmental regulatory requirements have been implemented to address the perceived problem. However, an already depressed oil and gas industry anticipates economic stress from expensive regulatory compliance, raising the dilemma of an apparent conflict between safeguarding the environment and preserving an economically viable petroleum industry. An intensive evaluation of the problem, identification of priority needs, and formulation of specific research and development projects were the major goals of an October, 1986 symposium. Critical needs and suggestions for identifying problems and possible solutions included: (1) brine characterization; (2) modification of zero discharge rule; (3) streamlining and simplifying the permit process; (4) encouraging land application of brines; (5) encouraging the beneficial reuse of produced waters; (6) expanding industry's efforts to educate the public; (7) evaluation of road spreading of brines; and (8) expansion of the underground injection option. (White-Reimer-PTT)
W89-10642

APPLICATION OF NATIONAL ENVIRONMENTAL REGULATORY PROGRAMS TO THE APPALACHIAN OIL AND GAS INDUSTRY,
Robinson and McElwee, Charleston, WV.
For primary bibliographic entry see Field 6E.
W89-10643

MANAGEMENT OF OIL AND GAS BRINES--PENNSYLVANIA'S REGULATORY PROGRAM,
Pennsylvania Dept. of Environmental Resources, Harrisburg. Bureau of Oil and Gas Management.
For primary bibliographic entry see Field 5E.
W89-10644

RECREATION AND CONSERVATION ALONG THE METROPOLITAN TORONTO WATERFRONT, LAKE ONTARIO, CANADA,
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geography.
I. P. Jolliffe.
Ocean & Shoreline Management, Vol. 11, Nos. 4 & 5, p 341-351. 3 fig, 3 ref.

Descriptors: *Toronto, *Canada, *Lake shores, *Conservation, *Recreation demand, *Water resources development, *Metropolitan water management, Urban planning, Land use, Air pollution, Water pollution control, Port authorities, Port facilities, Industrial development, Public access, Public participation, Erosion control, Lake Ontario.

Toronto, the most rapidly growing city in North America, is an excellent example of dynamic changes in its waterfront, involving both urban renewal and revitalization. Two key authorities are the Toronto Harbour Commissioners and the Metropolitan Toronto and Region Conservation Authority. Both have made a basic assumption that recreation and conservation go hand-in-hand. One powerful constraint on early recreational development along the waterfront was the high level of pollution of both air and water that inevitably accompanied port growth and industrialization along the central waterfront and in close proximity to the downtown business district. Industrial relocation has helped, but the problem of water quality still remains, exacerbated by sluggish circulation. In spite of a range of physical and other constraints, much of the Metro Waterfront is now publicly accessible, in particular a series of lake fills that have involved both public and private participation; and a range of cultural, scientific, wildlife conservation and recreational opportunities are now available. Some key problems still needing to be resolved are: severely eroding shorelines sectors, water quality and associated beach contamination, sedimentation problems, and shore and island land use management decisions. Overall, there has been a fairly successful wedding between recreational and conservation interests. (Fish-PTT)
W89-10663

NEW HORIZON FOR WATER QUALITY IN JAPAN,
Water Pollution Control Federation, Alexandria, VA.
For primary bibliographic entry see Field 4C.
W89-10692

WASTE MANAGEMENT: A LOOK TO THE FUTURE,
Environmental Protection Agency, Washington, DC. Office of Solid Waste and Emergency Response.
For primary bibliographic entry see Field 5E.
W89-10693

IMPACT ASSESSMENT OF ACID DEPOSITION CONTROL BILLS: AN EVALUATION OF SELECTED MODELS,
Cincinnati Univ., OH. School of Planning.
For primary bibliographic entry see Field 5B.
W89-10700

REDUCTION OF ACID GENERATION IN MINE TAILINGS THROUGH THE USE OF MOISTURE-RETAINING COVER LAYERS AS OXYGEN BARRIERS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
R. V. Nicholson, R. W. Gillham, J. A. Cherry, and E. J. Reardon.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 1-8, February 1989. 7 fig, 1 tab, 27 ref.

Descriptors: *Mine wastes, *Acid mine drainage, *Water pollution control, *Soil water, Sulfides, Oxygenation, Covers, Design criteria, Waste disposal, Ficks law, Performance evaluation.

Acid production in sulfidic tailings can cause severe degradation of water quality in both subsurface and surface systems. The availability of gaseous oxygen and the rate of diffusion of oxygen through the open pore spaces in the upper zone of the tailings are the critical factors controlling the rate of acid generation. Acid generation can be reduced by applying a fine-grained, nonreactive cover layer to the tailings surface. The key process involves moisture retention by capillary forces so that near-saturated conditions can be maintained even when the cover layer occurs at several meters above the water table. Textured layering of fine over coarse materials improves moisture retention in the fine layer when infiltration exceeds evapotranspiration. The application of such a cover layer theoretically can reduce oxygen diffusion coefficients and rates of acid generation of up to four orders of magnitude. This can represent a substantial difference in the potential treatment costs of tailings seepage. Simplified calculations based on Fick's first law can be applied to preliminary laboratory measurements of diffusion characteristics of potential cover materials to evaluate their effectiveness in reducing acidification. These concepts and methods provide an initial evaluation before field-scale testing of cover performance. (Author's abstract)
W89-10744

SEPARATE DISSOLVED AND PARTICULATE TRACE METAL BUDGETS FOR AN ESTUARINE SYSTEM: AN AID FOR MANAGEMENT DECISIONS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W89-10756

REGULATORY CONTEXT FOR CUMULATIVE IMPACT RESEARCH,
Dynamac Corp., Rockville, MD.
For primary bibliographic entry see Field 6G.
W89-10781

BIOMANIPULATION IV: DENSITY AND FEEDING ACTIVITY OF PLANKTIVOROUS

FISH (BIOMANIPULACJA. IV: ZAGESZCZENIE I AKTYWNOSC POKARMOIVA RYB PLANKTONOZERAYCH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
A. Jachner.
Wiadomosci Ekologiczne WEKLAF, Vol. 34, No. 2, p 143-163, 1988. 4 fig, 6 tab, 101 ref. English summary.

Descriptors: *Limnology, *Biomanipulation, *Aquatic productivity, *Lake restoration, *Fish conservation, Ecology, Fish behavior, Diurnal distribution, Feeding rates, Plankton, Larval growth stage, Predation, Zooplankton, Life cycles, Littoral environment, Algal control, Population density, Mortality, Daphnia, Europe.

Papers were reviewed concerning some aspects of fish ecology and biology, which seem to be important in the biomanipulation approach to lake recovery. Fish community structure, abundance, diurnal distribution, and feeding intensity should be known. Planktivorous fish species can be divided into three groups: (1) species which are planktivorous at larvae and fry stages (the majority of the European species) and are considered as bentivorous or predatory, (2) species which usually feed on zooplankton for the first year of their life or longer, and (3) species which are planktivorous for their whole life. Species which belong to the first group do feed on littoral cladocerans. Species from the second and third groups prey upon limnetic zooplankton, thus being important in controlling the density of big filtrators in offshore waters. Fish as visual predators choose the biggest and the most visible species of zooplankton, thus influencing the ability of the zooplankton community to control algal density. Young fish are known to start zooplankton feeding, and then to increase first the size of ingested prey and, after developing skills and morphology, they become more efficient predators. Density of planktivorous fish depends on zooplankton density and on density of predators. Density of planktivorous stages, i.e., larvae and fry, of the common fish species seem to be about 100 times higher than that of older, non-planktivorous stages. Taking into account high mortality of young stages, the density of planktivorous fish is higher than it would appear from fishery data. The main goal of biomanipulation then, would be to reduce the number of young fish to the level allowing Daphnia to develop to the densities, that would be able to keep algae under control. (Fish-PTT)
W89-10805

REALITIES OF WELLHEAD PROTECTION,
Caswell, Eichler and Hill, Inc., West Topsham, VT.
B. Caswell.
Water Well Journal WWJOA9, Vol. 43, No. 4, p 36-39, April 1989. 6 fig.

Descriptors: *Water policy, *Maine, *Water pollution prevention, *Wellhead protection, *Water resources development, *Aquifer management, *Environmental protection, *Land use, *Aquifer characteristics, Hydrologic data collections, Water districts, Potable water, Glacial aquifers, Clays, River flow, Pump wells, Drilling, Municipal water, Site selection, Recharge, Observation wells, Water level, Precipitation, Aerial photography, Maps, Pathogens, Public participation.

With the technical information that an aquifer study provides, the supplier and consumer can jointly formulate and adopt realistic and practical protective strategies. In the case of the water district that serves Lincoln, Maine, a detailed hydrogeologic investigation of the municipal groundwater resource was performed. The district obtains its potable water from a glacial esker aquifer flanked by clay deposits. Three production wells are situated on the northeast flank of the esker, where the sand and gravel is in direct contact with the Penobscot River and the clay beds of the small streams emptying into the river. The exposed esker gravel and possibly flow from the river provide aquifer recharge. Recently, a test drilling program was undertaken for the dual purpose of locating a new municipal well site and for fulfilling the wellhead protection requirements mandated by the state. Fourteen observation wells and one pump testing well were installed and tested along with the existing production wells. Local water levels and precipitation were measured, and all of the data were analyzed along with aerial photographs and field maps to define the aquifer boundaries and to determine the geologic and hydraulic characteristics of the esker aquifer. One measure of the relative importance of a recharge area is a 200-day time-of-travel zone, proposed to be adopted by Maine, that would define the area from which groundwater will reach a pumping well within a period of 200 days, presumably the longest time that a pathogenic organism can live in groundwater. For the Lincoln well, the 200-day travel time boundaries are located within the esker, making public control of the land overlying the esker critical. Ultimately, making wellhead protection area requirements work will depend on a correct combination of hydrogeologic information, public understanding and cooperation, and water district operation of the groundwater resource. Lincoln has the difficult job of making practical and political realities fit the newly understood hydrogeological realities. (Fish-PTT)
W89-10807

FAST TRACKING MILITARY WASTE,
Haley and Aldrich, Inc., Cambridge, MA.
W. E. Stimpson.
Civil Engineering CEWRA9, Vol. 59, No. 4, p 36-39, April 1989. 1 fig.

Descriptors: *Cleanup, *Contracts, *Bedford, *Groundwater pollution, Solvents, Chlorinated hydrocarbons, Infiltration, Decontamination, Monitoring, Regulations, Legal aspects, Massachusetts.

Within three years of the first feasibility study, contracts have been awarded to clean up disposal sites at the Hanscom Air Field in Bedford, MA, contaminated by spent fuels, paint thinners, solvents, solid wastes, and other combustible liquids. The primary contaminant is trichloroethylene, found in concentrations ranging from 0.5% in the soil and 0.1% in the groundwater. The remedial action plan calls for pumping contaminated groundwater to a central treatment plant located up to a mile away. Since the state would not allow discharge of any contaminants to the air, air stripping and off-gas treatment would be used to treat an estimated 300 gpm of water. Treated groundwater would be pumped back to two of the water disposal sites. The treated water would be infiltrated into the ground to flush remaining contamination from the soil. Open infiltration basins could not be used because they would probably attract birds; therefore, a radial infiltration system was devised to provide uniform distribution of water. (Doria-PTT)
W89-10817

BUILDING A BETTER LANDFILL LINER,
McClelland Engineers, Inc., Houston, TX.
B. R. Elsbury, and G. A. Sraders.
Civil Engineering CEWRA9, Vol. 59, No. 4, p 57-59, April 1989. 3 fig, 2 tab.

Descriptors: *Linings, *Landfills, *Clays, *Permeability, Construction, Ponds, Performance evaluation, Field tests, Leakage, Compaction, Soil types, Moisture content, Regulations.

Experiments were undertaken to identify the factors that affect the permeability of compacted soil liners, to analyze a liner constructed with full-sized construction equipment, and to determine whether the laboratory tests now in use can accurately predict field performance. A clay landfill liner was constructed and tested. In general, the specimens compacted in the laboratory were poor indicators of actual field performance; the tests of clay matching the density and moisture content of what was used in the field liner underestimated its permeability by up to 100,000 times. It is concluded that builders of landfills cannot rely on traditional criteria if they are going to produce a liner that meets standards. Soil clods must be eliminated and lifts properly bonded. While liner materials must still be tested in the field for density, moisture, grain size, and plasticity, careful, full-time observation of construction is probably a more important factor. Federal regulations require engineers to conduct in situ permeability tests on landfills destined to be used for hazardous waste, so many in that field already apply this simple principle. However, such tests are not commonly done at sites for the disposal of nonhazardous materials. Thus, paying special attention to the destruction of soil clods and the consolidation of lifts may substantially improve the liners of such landfills, and better protect the quality of our groundwater. (Doria-PTT)
W89-10819

HYDROGEOLOGY COMES TO THE SURFACE,
Harza Engineering Co., Chicago, IL.
For primary bibliographic entry see Field 2F.
W89-10820

DETERMINATION OF THE CRITICAL LOCATIONS IN A STOCHASTIC STREAM ENVIRONMENT,
Wyoming Water Research Center, Laramie.
Y. K. Tung.
Ecological Modelling ECMODT, Vol. 45, No. 1, p 43-61, February 1989. 3 fig, 6 tab, 27 ref.

Descriptors: *Water pollution control, *Stochastic hydrology, *Streams, *Dissolved oxygen, *Hydrologic models, Water quality, Mathematical equations, Mathematical studies, Distribution, Water quality standards, Correlation analysis, Environmental protection, Model studies.

In a deterministic stream system with dissolved oxygen (DO) problems, the critical point represents a unique location at which the DO concentration is at its minimum. From a regulatory viewpoint, it is this critical location which would present the greatest threat to violate the water quality standards. Therefore, to appropriately protect the stream environment from excessive DO depletion, the ability to determine the critical location deserves great attention. Four potentially usable criteria are presented for determining the critical locations in a stochastic stream environment. Among the four, it would seem that the critical location determined by the criteria of the maximum probability of violating a minimum water quality standard or the most likely point to be critical would be the most appealing from a practical viewpoint. The critical locations determined by the criteria were the downstream locations (miles) where the maximum DO deficit occurs. Therefore, more effort should be given in attempting to identify an accurate distribution for that location if such a criterion is to be used. It should be pointed out that in a limited study made by Tung and Hathhorn, a two-parameter gamma distribution, in a majority of the cases considered, best described the random characteristics of downstream locations. (Doria-PTT)
W89-10822

RECLAMATION OF ACID WATERS USING SEWAGE SLUDGE,
Freshwater Biological Association, Ambleside (England).
W. Davison, C. S. Reynolds, E. Tipping, and R. F. Needham.
Environmental Pollution ENPOEK, Vol. 57, No. 3, p 251-274, 1989. 8 fig, 2 tab, 25 ref.

Descriptors: *Lake restoration, *Acidic water, *Sludge utilization, *Neutralization, Sediments, Pyrite, Oxidation, Calcium hydroxide, Quarries, Sulfates, Sulfides, Chemical reactions, Chemical reduction, Incubation, Phytoplankton, Plankton, Vegetation, Insects, Fertilizers, Carbonates, Aluminum, Trace metals.

An exhausted sand quarry which had filled with acid water (pH 3) from the oxidation of pyrite was treated with calcium hydroxide to neutralize the water (pH 8), and sewage sludge to prevent further ingress of acid. The water remained neutral for 2 years, an appreciable quantity of base being generated by the reduction of sulfate to sulfide in the

anoxic sediment formed by the sewage sludge. Incubation experiments showed that the sewage sludge had a large capacity for sulfate reduction, which was equally efficient in acid or neutral waters and that the areal rate of consumption was sufficiently fast to neutralize all incoming acid, if at least 50% of the lake bed was covered with sludge. Throughout the course of the field investigations, there was no foul smell, and the lake was quickly colonized by phytoplankton, macrophytes, and insects. To ensure permanent reclamation, phosphate fertilizer could be added once the initial supply has been consumed. Neutralization removed trace metals from the system, presumably due to formation of insoluble oxyhydroxide and carbonates. The solubility of aluminum was apparently controlled by a basic aluminum sulfate. (Doria-PTT)
W89-10826

CONCEPTUAL MODEL OF GENETIC REGULATION OF MERCURY BIOGEOCHEMICAL CYCLING,
Electric Power Research Inst., Palo Alto, CA.
R. A. Goldstein, B. H. Olson, and D. B. Porcella.
Environmental Technology Letters ETLEDB, Vol. 9, p 957-964, 1988. 4 fig, 9 ref.

Descriptors: *Water pollution treatment, *Biochemistry, *Path of pollutants, *Genetic engineering, *Aquatic environment, *Biological engineering, *Model studies, *Water quality management, *Mercury, *Biotransformation, Heavy metals, Microbiological studies, Bioaccumulation, Toxicity.

As a result of the many advances in molecular genetics over the last decade, there exists the potential to manage toxic substances in the environment through the manipulation of specific genetic determinants of indigenous microbial communities. This potential is based on the ability to identify distinct sequences of genes (operons) which control specific environmental processes. By altering the density of these operons in the environment and the percentage of them that are functioning (expressed), the process rates that they control can be changed. The study of the interaction of genes with the environment has been termed genetic ecology. There exists a potential to manage the cycling of mercury within aquatic ecosystems by in situ manipulation of the genetic determinants of indigenous microorganisms. The objective is to reduce the availability, accumulation, and potential toxicity of mercury to macrobiota. Manipulation is directed towards changing the potential and expression of specific sets of genes, such as those that regulate the demethylation of mercury or its reduction from the ionic to elemental form. (Author's abstract)
W89-10834

DEVELOPING A METHODOLOGY FOR IN SITU MEASUREMENTS OF LOW PERMEABILITY SUITABLE FOR HAZARDOUS-WASTE LANDFILL,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 5E.
W89-10840

INCORPORATION OF BIOLOGICAL INFORMATION IN WATER QUALITY PLANNING,
Maine Dept. of Environmental Protection, Augusta.
D. L. Courtemanch, S. P. Davies, and E. B. Laverty.
Environmental Management EMNGDC, Vol. 13, No. 1, p 35-41, January/February 1989. 2 tab, 20 ref.

Descriptors: *Ecological effects, *Water quality management, *Planning, *Standards, Biological properties, Wastewater treatment, Rivers, Streams, Aquatic life, Water quality, Lakes, Ponds, Environmental policy, Maine.

Progress toward the goal of restoring integrity to the water in the United States has been difficult to assess. This difficulty may arise from the type of regulatory policy that has been traditionally used. With the advent of widespread wastewater treatment, the use of a planning approach employing receiving water impact standards may offer a more practical and direct means of defining and assessing integrity. Biological community response is shown to offer an integrated approach to implementing and evaluating water quality management policy. The state of Maine has revised its water quality law by utilizing biological community response to assess integrity. This law is presented as a model that employs impact measures and a planning approach for the implementation of water quality management policy. (Author's abstract)
W89-10846

COMPOSITION AND DISTRIBUTION OF THE MACROZOOBENTHOS OF THE RIVER STRUMA (C'STAV I RAZPREDELENIE NA MAKROZEESBENTOSA),
Bulgarian Academy of Sciences, Sofia. Inst. of Zoology.
For primary bibliographic entry see Field 2H.
W89-10855

PROCEEDINGS OF THE 43RD INDUSTRIAL WASTE CONFERENCE.
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10858

DEVELOPMENT OF A COMPUTERIZED MODEL FOR WASTE REDUCTION ALTERNATIVES,
Illinois State Water Survey Div., Savoy. Hazardous Waste Research and Information Center.
For primary bibliographic entry see Field 5D.
W89-10862

BIODEGRADATION OF STYRENE IN SOIL,
International Technology Corp., Knoxville, TN.
P. D. Kuhlmeier.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 67-73, 4 fig, 4 tab, 7 ref.

Descriptors: *Cleanup operations, *Biodegradation, *Soil contamination, *Styrenes, Biological treatment, Organic compounds, Soil treatment, Biochemical oxygen demand, Temperature, Microbiological studies, Hydrogen ion concentration.

A tanker truck spill of approximately 4900 gallons of styrene monomer into permeable soils prompted the initiation of a study to determine the feasibility of using in situ biological techniques to remediate the site. Styrene collected from two recovery wells was used for the bench-scale study. Site matrix groundwater samples were taken from the vacuum recovery system periodically in an effort to monitor ongoing treatment. Soil core samples taken from the local area served as the host media for column testing. Microorganisms adapted to styrene were imported from a wastewater treatment lagoon of a chemical company that was treating water containing styrene. Several conclusions can be drawn from the bench and field programs conducted: (1) at 20 C, styrene may be reduced at bench scale from a mean concentration of 70 mg/L to below the limit of detection within 25 hrs; (2) once a microbial population is acclimated to styrene substrate, mean concentrations of styrene may be reduced to below detection limits in approximately 10 hrs. Field results show average concentrations of styrene may be lowered to at least 0.05 mg/L economically; (3) based on a comparison of the ultimate biochemical oxygen demand and the theoretical oxygen demand, styrene was completely oxidized to carbon dioxide and water without the accumulation of incomplete oxidation product; and (4) it was observed from the field cleanup that the optimal pH and the minimum temperature range for significant biological activity were 6 to 7.5, and 50 to 55 C, respectively. (See also W89-10858) (Lantz-PTT)
W89-10867

EFFECT OF BACTERIA ADDITION ON BIODEGRADATION OF TOLUENE IN SUBSURFACE SOILS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Civil Engineering.
W. S. Farmer, K. G. Robinson, and J. T. Novak.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 75-81, 8 fig, 3 tab, 7 ref.

Descriptors: *Fate of pollutants, *Bacteria, *Biodegradation, *Toluene, *Soil contamination, Biological treatment, Adsorption, Hydrogen peroxide, Microbiological studies, Organic compounds.

Toluene is readily and extensively adsorbed when added to soil systems. After an initial fast adsorption, the aqueous concentration continues to decrease at a much slower rate. Thus, adsorption of toluene appears to be a two-stage process. When oxygen is limited, the extent of biodegradation was shown to be proportional to the amount of H2O2 added. Attention must be given to excessive concentrations of H2O2 due to the possibility of toxicity to the microorganisms. Acclimated microbes are able to degrade the extractable fraction of adsorbed toluene. However, a small unextractable portion remains undegraded. Desorption studies revealed that a majority of the adsorbed toluene desorbs rapidly into water. However, a biologically unavailable fraction (approximately 5%) remains bound to the soil. It appears that the microorganisms readily degraded the aqueous toluene and subsequently consume the bound toluene as it desorbs. (See also W89-10858) (Lantz-PTT)
W89-10868

IN SITU VITRIFICATION APPLICATIONS TO HAZARDOUS WASTES,
MAECORP, Inc., Homewood, IL.
S. C. Liikala.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 83-86, 1 tab, 3 ref.

Descriptors: *Water pollution treatment, *Waste treatment, *In situ vitrification, *Hazardous wastes, Electric currents, Soil contamination, Organic compounds, Inorganic compounds.

In Situ Vitrification (ISV) is a new hazardous waste remediation alternative for contaminated soil matrices. ISV utilizes electrical energy to melt contaminated soils into a durable glass form. An electric current is passed between electrodes placed in the soil which creates temperatures high enough to melt the soil and produce a molten mass. The vitreous zone pyrolyzes organic compounds and encapsulates the inorganic compounds. Process gases emitted from the melt are collected and routed through a process gas treatment system. When power to the electrodes is shut off, the molten mass cools into a glass form that resembles natural obsidian. Subsidence of the vitrification zone, due to soil densification, is then covered with clean backfill. The advantages of using ISV include: technology demonstrated at field scale; applicable to a wide variety of soils and contaminants; pyrolyzes organics and encapsulates inorganics; product durable over geologic time period; no threat of harm to the public from exposure; and application available for barrier walls and structural support. The use of ISV on a large scale basis has so far been limited to the nuclear industry but has potential for widespread applications to the hazardous waste field. With the ever changing regulations for the disposal of hazardous waste in landfills, and the increasing positive analytical data of ISV, the process will become a useful source for on-site treatment and hazardous waste management needs in the very near future. (See also W89-10858) (Lantz-PTT)
W89-10869

REMOVAL AND TREATMENT OF DISSOLVED AND FLOATING ORGANIC COMPOUNDS IN A CONTAMINATED GROUNDWATER,

EDI Engineering and Science, Grand Rapid, MI.
D. E. Strang, S. S. Tawney, and T. F. Klumgp.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 87-96, 8 fig, 2 tab.

Descriptors: *Water pollution treatment, *Organic compounds, *Groundwater pollution, Air stripping, Volatilization, Volatile organic compounds.

The removal of contaminants from groundwater by air stripping at the Dow Chemical Company's Beaver Creek Site, was achieved using three wells with a combined pumping capacity of 300 gallons per minute (gpm), treating the groundwater, and disposal of the effluent into an on-site seepage basin. Since no surface water or sanitary sewer system existed nearby, the effluent would have to be discharged to groundwater. Because of this, the effluent concentrations of benzene, toluene and ethyl benzene were required to below the detection limit, 1.0 micrograms/L. Air stripping was selected from several possible treatment options as the most cost effective method of treatment. The remediation system involves pumping 300 gpm of contaminated groundwater from three purge wells to the first of the two air stripping columns. The effluent from the first column is pumped to the top of the second column for final treatment. The first column was designed to remove an estimated 99.5% of the contaminants, leaving effluent concentrations above the detection limit and therefore not acceptable for groundwater discharge. The second column was to be used as a polishing unit, removing contaminants in the water stream to below the detection limit. The treated effluent from the second column is pumped through underground piping to a seepage pond, located approximately 300 ft west of the treatment process. Total surface area is approximately 30,000 sq ft. The required surface area was determined by performing a standard percolation test in the area. Three free product recovery wells were installed to capture the floating product. The three purge well system captured the highly contaminated portion of the plume, while Purge Well number 3, located at thet edge of the plume, had much lower corresponding concentrations. The process is yielding effluent quality below detection limits and, therefore, meeting the objectives of the Remedial Action Program and Regulatory Agency requirements. It is estimated that 30,000 lbs of VOC contaminants have been removed from the dissolved plume between September 1987 and April 1988. Approximately 7,500 lbs have been removed from the free product collection system since April 1, 1988. (See also W89-10858) (Lantz-PTT)
W89-10870

FIRST 'SITE' FIELD EVALUATION,
HAZCON, Inc., Brookshire, TX.
R. Funderburk.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 97-100.

Descriptors: *Water pollution treatment, *Wastewater treatment, *Field tests, *Hazardous wastes, Leaching, Permeability, Water pollution treatment, Permeability, Soil contamination, Organic compounds, Zinc, Lead, Toluene.

The first candidate technology has been tested under the EPA's new Superfund Innovative Technology Evaluation (SITE) program. It was a solidification/stabilization process developed specifically for hazardous waste streams with high organic content. The HAZCON process for solidification/stabilization of hazardous wastes was the first candidate tested under the new program. Selection and testing was due to HAZCON's claim to be able to solidify and stabilize highly organic hazardous waste streams that other processes could not treat effectively. The following are the most significant draft conclusions taken from the EPA report prepared on HAZCON: (1) permeabilities of the solidified soils were very low, 10 to the -8th cm/sec to nano-cm/sec, which is well below the 10 to the -7th cm/sec value that is considered in the industry to be impermeable; (2) the unconfined compressive strengths of the solidified cores ranged from 200-1,500 pounds/sq in; (3) the toxicity characteristic leaching procedure (TCLP) leaching tests of the solidified soils, which contained up to 100 mg/L of semivolatiles and even higher concentrations of volatiles, produced very low levels of metals, volatiles, and semivolatiles in the leachates. Essentially all values were below 1 mg/L which should allow compliance with most regulations; (4) values for many volatiles and phenols were in the 100-150 micrograms/L range; (5) except for lead and zinc, all metals were reduced to their detection limits. In the case of lead and zinc, their values were just above detection limits, in the range of 30-50 microg/L. Lead was present throughout the site in concentrations up to 24,000 mg/L; (6) although polychlorinated biphenyls (PCBs) were found throughout the site in an average concentration of 80 mg/L, quantification of PCBs in the leachate was not possible; and (7) toluene, injected purposely at a level of 125 mg/L, was detected in ranges from 1.3 to 28 mg/L. This is significant due to the concentrated nature in which the toluene was injected in its pure state by a hand pump. (See also W89-10858) (Lantz-PTT)
W89-10871

VOLATILIZATION OF PERCHLOROETHYLENE FROM STAGNANT WATER AND SOIL,
Windsor Univ. (Ontario). Dept. of Civil Engineering.
R. G. Zytner, N. Biswas, and J. K. Bewtra.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 101-108, 5 fig, 3 tab, 16 ref.

Descriptors: *Volatilization, *Polychlorinated biphenyls, *Wastewater treatment, *Water pollution treatment, *Soil treatment, *Soil contamination, Chemical treatment, Organic carbon, Soil properties.

The methods to determine the volatilization rates of perchloroethylene (PCE) from water and soil, and the mass transfer of PCE into a stagnant body of water, are presented. The volatilization rate of PCE from water was rapid and was a function of the area to volume ratio. Within 4.5 hrs, > 95% of the PCE had volatilized when the cross-sectional area/vessel volume was 81/m. Also, volatilization of aqueous PCE applied to soil was very rapid. However, it depended not only on the area to volume ratio, but also on the presence of organic carbon and the concentration of PCE applied. It was observed that the greater the organic carbon content, the more PCE was adsorbed on soil, and the lower was the volatilization rate. The volatilization rate indicates that if all the PCE is dissolved in water immediately after it enters the soil or water, no cleanup procedures may be required because the chemical will very quickly volatilize into the atmosphere. When pure PCE was applied to the soil, the volatilization rate was very low because it was adsorbed by the organic carbon in the soil. Thus, the organic carbon content of the soil plays a significant role in volatilization of pure PCE and soils high in organic carbon content may not exhibit a measurable volatilization rate. (See also W89-10858) (Lantz-PTT)
W89-10872

PREPARING A REMEDIAL DESIGN FOR CLEANUP OF THE NEW LYME SUPERFUND SITE,
Donohue and Associates, Inc., Sheboygan, WI.
D. W. R. Schultz, and R. J. Curnyn.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 109-114, 4 tab.

Descriptors: *Project planning, *Cleanup operations, *Water pollution treatment, *Superfund, Computers, Design standards, Management planning.

The remedial design process for the New Lyme Superfund Site project included preparation and submittal of seven deliverables for use in the bidding process. The process required approximately one year to implement. Four design stages were included from conceptual through preliminary, final, and bid document stage. Throughout this process, approximately 75 to 100 people outside of Donohue were involved in the review of the deliverables and in preparation of the design documents. In addition, 12 technical disciplines were involved in preparation of the project deliverables. The cooperative agreement between the Corps of Engineers and the EPA, in conjunction with the design review process implemented by the Corps, provides the opportunity to take advantage of the strengths of each organization involved. The Corps of Engineers system is evolving to adapt to Superfund requirements. All agencies involved in this project are developing and evolving improved methods to implement the Superfund cleanup requirements. Due to the large number of people involved and disciplines represented in this project, a very tight discipline control system was required to assure that design goals were met. Weekly meetings were held during the design process to assure that the project proceeded in a manner consistent with the design goals. Continuous interaction with the Corps project manager was required to handle day-to-day issues and questions arising from preparation of the design documents. Continuous interaction facilitated effective use of the design meeting as a tool to review all of the documents constructively and incorporate the hundreds of review comments correctly. Three review meetings were held during the design process. For a project of this magnitude, these design review meetings were critical to meeting the goals of the project. The use of computer-aided design (CAD) and drafting for this project was important because of the large number of drawings and the number of changes required after each design submittal stage. Approximately 80 design drawings were included in the construction drawing set. Use of CAD for the preparation of these drawings allowed for changes to be made quickly after each design review meeting. The project would have required several additional months had manual drafting been used. (See also W89-10858) (Lantz-PTT)
W89-10873

DESIGN CONSIDERATIONS FOR A WISCONSIN PAPER MILL LANDFILL,
Becher-Hoppe Engineers, Inc., Wausau, WI.
For primary bibliographic entry see Field 5E.
W89-10875

PRELIMINARY ASSESSMENT OF A MICROFILTRATION/REVERSE OSMOSIS PROCESS FOR THE TREATMENT OF LANDFILL LEACHATE,
Zenon Environmental, Inc., Burlington (Ontario).
For primary bibliographic entry see Field 5D.
W89-10882

COMPARISON OF GLUCOSE AND METHANOL AS CARBON SOURCES FOR DENITRIFICATION IN BIOLOGICAL TREATMENT OF LEACHATE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10883

STORMWATER RUNOFF CONTROL: AN OPERATIONAL DIFFICULTY FOR ABOVEGROUND INDUSTRIAL WASTE LANDFILL,
AWARE, Inc., Nashville, TN.
G. Selvakumar, and M. S. Quinn.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 203-212, 10 fig, 5 tab.

Descriptors: *Solid waste disposal, *Water pollution prevention, *Landfills, *Waste disposal, *Storm runoff, Industrial wastes, Leachates, Design standards, Geomembranes, Waste management.

The control of stormwater runoff is an essential component for an environmentally sound oper-

ation of a solid waste landfill. Typically, through the use of cover soils, steep side slopes, erosion controls, vegetation, and drainage systems, the amount of stormwater runoff is maximized, therefore, the amount of leachate generated and ultimately collected for treatment (via a properly designed liner), is minimized. This paper is a case history of a landfill design that does not utilize typical leachate minimization controls, since the volume loss associated with these controls was not acceptable. In order to optimize the permitted landfill space and maintain compliance with State regulations, a state-of-the-art leachate containment, leachate collection, and stormwater containment system was incorporated into the design and operation of the landfill. These controls were facilitated by the availability of an existing on-site permitted wastewater treatment system, and by the properties of the wastewater treatment plant sludge (WTPS) that will be disposed of in the landfill. The WTPS was shown to have only nominal environmental effects when left uncovered (i.e., the WTPS does not create a fire hazard, dust, litter, odor problem, or a vector problem when left exposed), therefore, a variance on the use of daily and intermediate cover soil was granted. The volume typically lost to cover soils and sand blanket drains was made available for additional WTPS disposal through a filling and stormwater control system, and the use of geonets and geomembranes in the leachate containment system. The use of both geonets and geomembranes the thickness of the liner system, thereby optimizing the capacity of the landfill cell. Specifically, the geonets reduced the thickness of the sand blanket drain in the primary collection system and eliminated the use of sand in the secondary collection system. The use of geomembranes vastly improved the liner's containment efficiency without a measurable volume loss. The improved containment also reduced the necessary drainage capacity specification of the secondary collection system. This facilitated the use of geonets and the elimination of sand as a component of this system. (See also W89-10858) (Lantz-PTT)
W89-10884

CONTROL OF METHANE FROM MUNICIPAL SOLID WASTE LANDFILLS BY INJECTION OF LIME AND FLYASH,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
R. N. Kinman, J. Rickabaugh, M. Lambert, and D. L. Nutini.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 239-250, 6 fig, 11 tab, 3 ref. EPA Contract 68-03-3379.

Descriptors: *Water pollution control, *Waste disposal, *Landfills, *Lime, *Solid waste disposal, *Methane, Municipal wastes, Biodegradation, Hydrogen ion concentration, Leachates, Fly ash.

Pressure injection grouting of lime slurry has been used for a variety of purposes. In recent years this technique has been used with lime/flyash slurries for prevention of methane gas formation and stabilization at sanitary landfills. In the landfills the grout is injected such that all or most of the void space is filled with the slurry. Since field applications of this method have simply injected as much lime/flyash slurry as possible, there is no indication of the actual amount of lime slurry needed to prevent methane gas generation. Due to the difficulty in developing a reliable methane collection system it is not practical to answer these questions at a field site. Therefore, six experimental sanitary landfills housed in the US EPA Center Hill Solid and Hazardous Waste Research Facility in Cincinnati, Ohio, were injected with lime or lime/flyash mixtures to evaluate this procedure for methane prevention. Lime, Ca(OH)2, in the two highest doses appeared to exert some toxicity to the methane formers, which resulted in approximately a 44% reduction (as compared to the control cell) in total gas production. Lime in lower doses also appeared to exert some toxicity to the methane formers but was only able to reduce gas production to 75% to 83% of the control cell. Lime plus flyash (lime in a lower dose) appeared to seal off some of the refuse from biological activity. It is unclear how much reduction in gas production was attributable to the flyash. Lime appeared to cause an increase in methane concentrations in the gas by neutralization of CO2, and to increase and stabilize the pH of the leachate in the optimum range for methane formation; pH 6.8-7.2. Lime and lime/flyash injections held more moisture within the refuse mass--less leachate was produced in the injected cells. There was no appreciable change in leachate quality resulting from the lime injection as measured by heavy metals concentrations in the leachate. Injected material followed the path of least resistance to fill void spaces in the refuse. This resulted in many pockets of slurry which were unreacted after the 17 month project period. One time injections of lime and lime/flyash mixtures are not capable of stopping methane production. (See also W89-10858) (Lantz-PTT)
W89-10885

DEGRADATION OF ACETONITRILE BY PSEUDOMONAS AERUGINOSA,
Selma Univ., AL. Div. of Natural and Applied Sciences.
M. Nawaz, J. D. Richardson, K. D. Chapatwala, and J. H. Wolfram.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 251-256, 4 fig, 3 tab, 19 ref. EG&G Idaho Inc. subcontract C85-110800.

Descriptors: *Biodegradation, *Acetonitrile, *Wastewater treatment, *Water pollution treatment, *Pseudomonas, Microbiological studies, Bacteria, Microbial degradation.

Nitrile compounds and their derivatives are used in increasing amounts in a number of industrial operations as chemical solvents, extractants and recrystallizing agents. Consequently, there is also a concomitant increase in the dissemination of these chemicals into the environment via the industrial wastewater streams. Biodegradation, the microbial transformation of organic compounds, has been recognized as an effective process for the removal of toxic chemicals from the environment. In this study, among the 60 soil and water samples drawn from different ecosystems, only sample No. 16 yielded bacteria capable of growth on acetonitrile as sole source of carbon and energy. The isolate was rod shaped, gram negative bacteria and identified as Pseudomonas aeruginosa. The bacterial isolate was able to utilize various nitrile compounds, however, acrylonitrile, benzonitrile, malonitrile and acrylamide strongly inhibited growth even at lower concentrations. The bacterial isolates readily oxidized the acetonitrile up to 25 micrograms/L, however, respiration was strongly inhibited at 30 microg/mL of the substrate. These results suggest that the bacterial isolate has the ability to utilize high concentrations off acetonitrile, as sole source of carbon and energy. The authors therefore propose that this isolate might be exploited to grow on nitrile pollutants, particularly where the pollutant concentrations are high. (See also W89-10858) (Lantz-PTT)
W89-10886

NOVEL APPROACH TO SIMPLIFIED RESPIROMETRIC OXYGEN DEMAND DETERMINATIONS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-10909

DESIGN CONSIDERATIONS FOR PACKED COLUMNS REMOVING MANGANESE FROM MINING SEEPAGE,
Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10925

WASTE MINIMIZATION IN HISTORICAL PERSPECTIVE,
Illinois Hazardous Waste Research and Information Center, Savoy.
C. E. Colten.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 739-744, 49 ref.

Descriptors: *Waste management, *History, *Regulations, *Waste disposal, *Waste treatment, Economic aspects, Legislation, Costs, Water pollution control.

While economic concerns generally determined whether waste reduction technology is actually installed or not, legislation and improved technology figured prominently in the history of waste minimization. During the first quarter of this century, the public health community perceived biological wastes as the primary health threat. Partly in response to nuisance legislation, and also reacting to crisis interruptions in raw materials, manufacturers which generated putrescible wastes made significant progress in reducing their effluent. Following the First World War, coke wastes and pickle liquors began to receive close scrutiny by public agencies and manufacturing engineers. During the post-1930 era, their primary goal was to find marketable by-products. There were short-term crisis-oriented waste reductions efforts during the 1940s, but the Clean Water Act of 1965 prompted a renewed interest in waste reduction. An economic incentive for by-product development has always existed, but the cost inherent in finding a marketable product has also been present. Nevertheless, notable achievements were made during times of major technological innovation and as a result of even imperfect legislation. As market incentives are developed for waste reduction, the historical significance of technological improvement and pollution control legislation must be remembered. Legislation and enforcement spurred experimentation, but they must be complemented by viable markets for by-products. (See also W89-10858) (Lantz-PTT)
W89-10935

IMPROVEMENTS TO A SEPTAGE REGULATION PROGRAM FOR A MAJOR MIDWESTERN CITY,
Montgomery (James M.) Consulting Engineers, Inc., Los Angeles, CA.
D. R. Bertelson.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 761-768, 3 fig, 4 tab, 4 ref.

Descriptors: *Septic tanks, *Wastewater treatment, *Regulations, *Wastewater management, *Waste disposal, Information exchange, Economic aspects, Domestic wastes, Payment, Wastewater facilities.

A midwest City operates two Advanced Wastewater Treatment (AWT) Facilities which serve approximately 700,000 people in two counties. Both AWT's include the processes of nitrification and ozone disinfection following conventional primary sedimentation and bioroughing trickling filter processes. In addition to those served by the treatment facilities, there are approximately 300,000 additional people in the service area who utilize septic tanks as their means of wastewater treatment and several hundred new septic tanks are approved for installation each year. One of the two AWT's has been the approved disposal site for the area's septage for many years. With the implementation of an Industrial Pretreatment Program, it became necessary for the City to address the potential problems associated with the disposal of septage at the AWT. In addition, industrial wastewater disposal was now addressed under the 'domestic sewage exclusion' and 'permit by regulation' portions of the Resource Conservation and Recovery Act (RCRA), forcing the City to take a closer look at it's septage disposal practices. This study investigates a means of effectively regulating the septage haulers, and a way to protect the AWT from upsets and the City from liability for accepting a RCRA hazardous waste, by discussing the following relevant issues: (1) the City had no data base for septage; (2) the rates charged for septage

disposal appeared to be too low; (3) the existing system for billing and tracking haulers was inadequate; and (4) the city was being asked to accept hauled wastes which were neither domestic septage nor RCRA wastes and for which no clear guidelines for screening or billing existed. (See also W89-10858) (Lantz-PTT)
W89-10937

ACID RAIN: THE EMERGING LEGAL FRAMEWORK,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W89-10966

SCIENTIFIC UNCERTAINTY, AGENCY INACTION, AND THE COURTS,
New York State Dept. of Law, Albany.
For primary bibliographic entry see Field 6E.
W89-10968

SOURCE-RECEPTOR RELATIONSHIPS: THE CANADIAN EXPERIENCE,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W89-10973

SOURCE-RECEPTOR RELATIONSHIPS AND CONTROL STRATEGY FORMULATION,
Argonne National Lab., IL. Environmental Research Div.
D. G. Streets.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 165-181, 9 fig, 1 tab, 35 ref. DOE Contract W-31-109-Eng-38.

Descriptors: *Path of pollutants, *Water pollution control, *Acid rain, *Water pollution sources, Mathematical models, Lagrangian method, Eulerian method, Mathematical studies, Air pollution, Costs, Atmospheric chemistry, Optimization, Atmospheric physics, Legislation.

The source-receptor relationship is an important outgrowth of current understanding of the physical and chemical processes occurring in the atmosphere. Because of the great complexity of the atmosphere, knowledge of this relationship is limited, therefore limiting the formulation of a control strategy. Three types of strategies are discussed: emissions-optimized, in which one seeks to reduce emissions wherever they are greatest; cost-optimized, in which one seeks to reduce emissions wherever it is cheapest to do so; and deposition-optimized, in which one seeks to reduce emissions wherever it will lead to the most cost-effective reduction in deposition at a particular receptor site or set of sites. This third strategy is the one that takes advantage of source-receptor relationships. As with all scientific investigations, control strategy analysis is limited by the tools that are available. All studies performed to date have used Lagrangian atmospheric transport and deposition models. These models can be described as semiempirical, in that they derive their credibility in part from describing observations rather than from providing detailed mechanistic explanations of molecular behavior. More advanced Eulerian models are under development, but their comprehensive, mechanistic treatment of atmospheric chemistry imposes severe computational limitations on control strategy analysis. While results from the comprehensive Eulerian models are anxiously awaited, efforts to date suggest that the results from Lagrangian models will have to be modified in light of nonlinear chemistry, but that these models are unlikely to alter the broad features of source-receptor relationships. Of the 50 or more bills introduced to Congress since 1981 for the control of acid rain, only one specifically recognized the importance of the source-receptor relationship in establishing a control program. (See also W89-10965) (Lantz-PTT)
W89-10974

MODELLING NUTRIENT RETENTION BY A REEDSWAMP AND WET MEADOW IN DENMARK,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 2H.
W89-10982

SOME SIMULATION MODELS FOR WATER QUALITY MANAGEMENT OF SHALLOW LAKES AND RESERVOIRS AND A CONTRIBUTION TO ECOSYSTEM THEORY,
Ceskoslovenska Akademie Ved, Ceske Budejovice. Biomathematical Lab.
M. Straskraba, and P. Mauersberger.
IN: Wetland Modelling. Developments in Environmental Modelling, 12. Elsevier Scientific Publishing, New York. 1988. p 153-175, 5 fig, 1 tab, 47 ref.

Descriptors: *Simulation analysis, *Shallow water, *Limnology, *Water quality management, *Lakes, *Model studies, *Reservoirs, Czechoslovakia, East Germany, Hydrologic models, Theoretical analysis, Ecosystems, Optimization, Performance evaluation, Dynamics, Model testing, Thermodynamics, Comparison studies, Systems analysis, Water quality standards, Cost analysis.

Two opposing approaches to model complexity exemplified by models developed for shallow flow-through lakes in the German Democratic Republic (GDR) and for reservoirs in Czechoslovakia are demonstrated: detailed realistic models with many variables, and simple but more general models. The models were successfully applied to several actual water quality problems. Based on scenarios simulating water quality, management strategies were made for Lake Grosser Muggelsee and reservoirs in Czechoslovakia, East Germany and the USSR. By including costs for different management options, simulation models were extended to optimization models. They calculate explicitly the least cost strategies while conserving some water quality criteria. Multiparametric dynamic optimization methods were used for numerical model solutions. However, inherent inadequacies of the present modeling methodology were recognized. Ecosystems possess higher order dynamics (self-adaptation and self-organization capabilities) usually not covered by the models. Most functional relations are derived empirically, with less underlying theory. Two theoretical developments to overcome the difficulties are outlined: thermodynamic and cybernetic. Both are based on assumed optimality criteria for ecosystem behavior. One utilizes ideas derived primarily from physics and chemistry and the other one from economy and general systems theory. A recent attempt to compare the two specific approaches in detail proved that they can be mutually complementary. However, both independent development of the two approaches as well as their comparisons must continue. (See also W89-10975) (Lantz-PTT)
W89-10983

BIOLOGICAL INDICATORS OF FRESHWATER POLLUTION AND ENVIRONMENTAL MANAGEMENT,
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 5A.
W89-10986

REPORT OF THE NATIONAL WORKSHOP ON INSTREAM BIOLOGICAL MONITORING AND CRITERIA.
For primary bibliographic entry see Field 5A.
W89-10987

MICHIGAN WATER WELL GROUTING MANUAL: A GUIDE FOR THE CONTRACTOR,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
For primary bibliographic entry see Field 8A.
W89-10989

THERMAL MITIGATION STUDY COMPLIANCE WITH THE FEDERAL AND SOUTH CAROLINA WATER QUALITY STANDARDS.
Department of Energy, Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161, as DE88-011441. Price codes: A06 in paper copy, A01 in microfiche. Report No. DOE/SR--5003, October 1984. 137p, 40 fig, 23 tab, 5 ref, append.

Descriptors: *South Carolina, *Savannah River, *Water quality standards, *Nuclear reactors, *Thermal pollution, *Water pollution control, *Water quality control, Rubble dams, Cooling ponds, Recirculated water, Stream classification, Cooling towers, Powerplants, Federal jurisdiction, State jurisdiction.

In November 1982, the Department of Energy (DOE) was notified by the State of South Carolina's Department of Health and Environmental Control (SCDHEC) that the major Savannah River Plant (SRP) thermal discharges would have to attain the State of South Carolina's Class B water quality standards in onsite streams rather than in the Savannah River. These major thermal discharges included those from C-, K-, L--(then undergoing refurbishment), and P-reactors and the D-area coal-fired power plant. In this Thermal Mitigation Study, a three-step screening process was used to determine the reasonable compliance alternatives that could be implemented for C--and K-reactors and the D-area coal-fired power plant and meet existing regulations. The three-step screening process included the identification of possible alternatives; the selection of feasible compliance alternatives; and the selection of reasonable compliance alternatives. In identifying and screening the cooling water alternatives, two broad categories of alternatives were identified. These included a category of alternatives that could comply explicitly with the EPA's water quality standards and the State of South Carolina's Class B water quality standards, and a category of alternatives such as rubble dams, spray canals, and small cooling lakes that could provide partial thermal mitigation but would fall short of meeting Class B water quality standards. To implement these alternatives, or to continue the current cooling water systems, a new South Carolina stream classification would have to be developed by completing a use-attainability analysis as required by EPA. For the category of cooling water alternatives that could meet South Carolina Class B water quality standards, the screening process was used to select the most reasonable compliance alternatives for C--and K-reactors and the D-area coal-fired power plant, and included the same five basic systems: a recirculating cooling tower, a once-through cooling tower, a cooling lake, a cooling lake followed by a once-through cooling tower, and a once-through cooling tower followed by a cooling lake. For the D-area coal-fired power plant, the reasonable compliance alternatives selected include direct discharge to the Savannah River and increased flow with mixing to reduce the discharge temperature. (Lantz-PTT)
W89-10992

RESIDUAL EXPLOSIVES CRITERIA FOR TREATMENT OF AREA P SOIL, LOUISIANA ARMY AMMUNITION PLANT,
Army Biomedical Research and Development Lab., Fort Detrick, MD.
M. J. Small.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 799. Price codes: A04 in paper copy, A01 in microfiche. Technical Report 8807, May 1988. 59p, 5 fig, 6 tab, 44 ref, 4 append.

Descriptors: *Explosives, *Water pollution sources, *Water quality standards, *Soil contamination, *Louisiana, *Decontamination, *Cleanup operations, *Industrial wastes, Water pollution effects, Groundwater pollution, Trinitrotoluene, Cyclotrimethylene trinitramine, Cyclotetramethylene tetranitramine, Regulations, Organic compounds, Toxicity, Military reservations, Surface water, Incineration, Public health.

From about 1950 to 1980, the Louisiana Army Ammunition Plant, near Shreveport, discharged wastewater from its explosives load, assembly, and packed activities into a complex of leaching pits known as Area P. The groundwater under Area P has been found to contain the explosive TNT (trinitrotoluene), RDX (cyclotrimethylene trinintramine), and HMX (cyclotetramethylene tetranitramine) as well as related compounds. The Army plans to incinerate soil that has been excavated from this area to a limited depth. An assessment of this plan from health effects viewpoint was requested, details of which are documented in this report. Three situations were addressed, those of potable groundwater, safety of surface water for aquatic life, and future construction activities. State regulations require the uppermost aquifer to be addressed as a potential water supply; at Area P, the uppermost aquifer is the alluvial aquifer. The assessment concluded that current levels of explosive contamination in groundwater probably exceed acceptable levels of drinking water quality. Thus, an evaluation was done to determine residual soil target levels for treated and untreated soil at Area P that would provide acceptable levels of drinking water quality. For most explosives involved, the soil target levels are on the order of 0.1 to 1 mg/kg. A second evaluation led to a set of soil levels that should prevent adverse aquatic effects in the nearest surface water. TNT and RDX levels in surface soil and drainage ditch soil samples are in excess of these. Thus, the proposed removal and treatment of the top foot of soil in Area P should be undertaken. (Lantz-PTT)
W89-10997

SELECTION CRITERIA FOR MATHEMATICAL MODELS USED IN EXPOSURE ASSESSMENTS: GROUND-WATER MODELS,
Environmental Protection Agency, Washington, DC. Office of Health and Environmental Assessment.
F. Bond, and S. Hwang.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-248752. Price codes: A10 in paper copy, A01 in microfiche. Report No. EPA/600/8-88/075, May 1988. 225p, 2 fig, 3 tab, 43 ref, append. EPA Contract 68-01-6939.

Descriptors: *Population exposure, *Model studies, *Standards, *Mathematical models, *Groundwater management, *Groundwater movement, Comparison studies, Groundwater pollution, Hydrologic models, Decision making.

Prior to the issuance of the Guidelines for Estimating Exposures in 1986, the US EPA published proposed guidelines for public review and comment. The purpose of the guidelines is to provide a general approach and framework for carrying out human and nonhuman exposure assessments for specific pollutants. As a result of the review process, four areas were identified that required further research. One of these was the area of selection criteria for mathematical models used in exposure assessments. The purpose of this document is to present criteria that provide a means for selecting the most appropriate mathematical model(s) for conducting an exposure assessment related to groundwater contamination. General guidelines and principles for model selection criteria are presented followed by a step-by-step approach to identifying the appropriate models are grouped into categories and a framework is provided for selecting the appropriate model(s) based on the response to the technical criteria. Brief summaries of all the currently available models discussed in this report are contained in the appendix. Two site-specific example problems are provided to demonstrate the procedure for selecting the appropriate mathematical model for a particular application. (Author's abstract)
W89-10998

LOCATING AND REPAIRING LEAKS IN LANDFILL/IMPOUNDMENT FLEXIBLE MEMBRANE LINERS,
Environmental Protection Agency, Cincinnati, OH.
R. E. Landreth.
Available from the National Technical Information Service, Springfield, VA 22161, as PB88-249651. Price codes: A03 in paper copy, A01 in microfiche. Report No. EPA/600/D-88/1183, August 1988. 11p, 2 fig, 8 ref.

Descriptors: *Wastewater lagoons, *Liners, *Materials engineering, *Maintenance, *Landfills, *Water pollution prevention, *Waste disposal, Leaching, Geomembranes, Permselective membranes, Permeability, Electrical properties, Membrane liners, Leakage, Measuring instruments, Electrodes, Solid wastes, Hazardous materials, Leachates, Adhesives, Sealants.

Large quantities of solid and hazardous wastes generated each year are commonly disposed of in landfills and surface impoundments. Because the liquids (leachates) in surface impoundments and landfills are frequently toxic, nearby surface water, groundwater, and soil must be protected. Geomembrane liners (flexible membrane liners, FMLs) are often used to form an impermeable barrier to prevent migration of contaminant liquids to nearby soil and water. The factory-fabricated sheets of polymeric materials are seamed together at a field site to form a continuous barrier between the landfill/impoundment (L/I) waste and the surrounding environment. As a pollution barrier this FML must be sound and without defect. The accuracy of surface earth potential measurements to locate leaks depends on several factors. The presence of instrument noise, poor electrical contact between the ground and the electrodes, localized inhomogeneities of the surface resistivity, electrode polarization noise, and the presence of interfering signals such as electrical power line interference all serve to decrease accuracy. A half-cell electrode, which reduces polarization noise significantly, was used in the tests. The electrical leak location (ELL) method, adapted to make surface soil potential measurements with the use of half-cell electrodes, was well suited for locating leaks in L/I FMLs with protective soil covers. Small leaks were located in an FML covered with soil without the need for an overlaying conductive layer of liquid. To reduce electrode contact noise, the electrodes were inserted into the soil to penetrate the dry surface soil. It was determined that surveys can be performed after the protective soil is put in place so that leaks caused by placing the soil can be located. The methods used to seam and test the seam quality of a particular FML are the same ones used to repair that FML. FMLs can be seamed with the use of: thermal methods, solvent methods, adhesives, and tape adhesives. (Lantz-PTT)
W89-11005

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ECOLOGICAL PLANNING: A POSSIBLE METHOD FOR THE CHOICE OF AQUACULTURAL SITES,
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.
E. Dutrieux, and O. Guelorget.
Ocean & Shoreline Management, Vol. 11, No. 6, p 427-447, 1988. 9 fig, 4 tab, 28 ref.

Descriptors: *Lagoons, *Aquaculture, *Water resources development, *Systems analysis, *Management planning, Ecosystems, Environmental protection, Water use, Stages, Mapping.

A methodology is presented for the global study of the lagoonal ecosystem. The results reveal the potentialities of the site, regarding various types of development such as aquacultural activities or the protection of the site. Investigations, along with a bibliographical study, enabled adaptation of the methodology of ecological planning to the development of the lagoonal site. This methodology follows the classic three-stage pattern, as follows: (1) First stage: an ecological survey of the lagoonal system, using a list of descriptors that will best express the complexity of the system; (2) Second Stage: use of the ecological survey to determine the possibilities of the milieu, describing the various activities envisaged (aquacultural development and protection of the site), and translated in terms of potentialities for the various possible uses; and (3) Third Stage: through superimposition (either cartographical or otherwise), using a planning scheme for the various activities in the lagoonal area, and taking the ecological potentialities of the milieu into maximum account. (Author's abstract)
W89-10664

INCORPORATION OF BIOLOGICAL INFORMATION IN WATER QUALITY PLANNING,
Maine Dept. of Environmental Protection, Augusta.
For primary bibliographic entry see Field 5G.
W89-10846

PREPARING A REMEDIAL DESIGN FOR CLEANUP OF THE NEW LYME SUPERFUND SITE,
Donohue and Associates, Inc., Sheboygan, WI.
For primary bibliographic entry see Field 5G.
W89-10873

DESIGN OF AN EXPERT SYSTEM FOR EARLY ENVIRONMENTAL ASSESSMENT OF MANUFACTURING PROCESSES,
Merck Sharp and Dohme Research Labs., Rahway, NJ.
For primary bibliographic entry see Field 5D.
W89-10905

USING A WASTE AUDIT APPROACH TO DETERMINE WASTE MANAGEMENT ALTERNATIVES AT A PRINTED CIRCUIT BOARD MANUFACTURING PLANT,
Canviro Consultants Ltd., Waterloo (Ontario).
For primary bibliographic entry see Field 5D.
W89-10912

INTERIM REPORT ON 1985-86 HIGH WATER LEVELS IN THE GREAT LAKES-ST. LAWRENCE RIVER BASIN.
International Joint Commission-United States and Canada, Washington, DC.
For primary bibliographic entry see Field 2E.
W89-10954

GROUNDWATER MODELLING, THREE DIFFERENT APPLICATIONS OF A COMPUTER CODE FOR SIMULATION OF GROUNDWATER FLOW,
VBB/SWECO Consulting Group, Stockholm (Sweden).
For primary bibliographic entry see Field 2F.
W89-11017

6B. Evaluation Process

COMPUTER-BASED METHODOLOGY TO DEVELOP THE ECONOMICS OF ENVIRONMENTAL CHANGE WITHIN RIVER-ESTUARY-COASTAL SYSTEMS,
Old Dominion Univ., Norfolk, VA. Coastal Engineering Inst.
For primary bibliographic entry see Field 2L.
W89-11062

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D.
W89-10793

6D. Water Demand

RECREATION AND CONSERVATION ALONG THE METROPOLITAN TORONTO WATERFRONT, LAKE ONTARIO, CANADA,
Royal Holloway and Bedford New Coll., Egham (England). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W89-10663

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics.
J. K. Harper, and J. W. Mjelde.
Resource Management and Optimization RMOPDH, Vol. 6 No. 1, p 45-58, December 1987. 1 fig, 3 tab, 17 ref.

Descriptors: *Public ownership, *Water use, *Irrigation programs, *Cost analysis, *Economic aspects, Public waters, Water costs, User charges, Irrigation canals, Rice, Cropland, Texas.

An analysis was conducted of the implications of public ownership on rice irrigation water use and water price in the Texas Rice Belt. The analysis tested the hypothesis that the form of ownership has no effect on water use patterns and water price per acre. Results indicate that the form of ownership has a significant impact on irrigation water use per acre and on water price per acre. The change of canal systems from private to public ownership has on average increased water use per acre. Further, publicly owned canal systems charge less per acre for first crop rice irrigation water than privately owned canal systems. No significant difference in second crop rice irrigation water price was found between the publicly owned and privately owned systems. (Author's abstract)
W89-10793

SYSTEM ANALYSIS OF AN IRRIGATION MAIN CANAL,
Utah State Univ., Logan. Dept. of Chemistry.
For primary bibliographic entry see Field 3F.
W89-11038

6E. Water Law and Institutions

ASSESSMENT OF SLUDGE REGULATION ASSUMPTIONS,
Black and Veatch, Kansas City, MO.
R. D. Kuchenrither.
BioCycle BCYCDK, Vol. 30, No. 4, p 68-70, April 1989. 4 tab, 3 ref.

Descriptors: *Risk assessment, *Population exposure, *Waste disposal, *Regulations, *Sludge disposal, Heavy metals, Land disposal, Monofilling, Incineration, Risks, Algorithms, Cadmium, Copper, Zinc, Lead, Nickel, Toxicity.

An assessment of the basic concepts of the background assumptions that were used to develop various aspects of the EPA sewage sludge disposal regulations is presented. The five utilization/disposal practices that are covered in the proposed regulations are: land application; distribution and marketing; monofilling; surface disposal sites; and incineration. Two categories of risk are considered: the most exposed individual; and aggregate risk. In assessing the risk to the most exposed individual, EPA developed various pathways of exposure and then developed a mathematical algorithm to describe that pathway and the effects on the most exposed individual. The aggregate risk would be some measure of the risk to society as a whole from exposure to various sludge disposal scenarios. The metal limits were then compared for five metal limits under the old guidelines and the new proposed limits. Even though cadmium produced a human health limitation, its allowable application rate actually increased by approximately three times over the previous limit. Concentrations of copper and zinc were reduced substantially based upon yield reductions of lettuce crops from elevated concentrations of these metals. The limitation of lead was due to potential toxicity to predators of soil biota, and the actual allowable limits for nickel were increased slightly over the old limits. (White-Reimer-PTT)
W89-10639

APPLICATION OF NATIONAL ENVIRONMENTAL REGULATORY PROGRAMS TO THE APPALACHIAN OIL AND GAS INDUSTRY,
Robinson and McElwee, Charleston, WV.
D. M. Flannery.
Northeastern Environmental Science NOESDE, Vol. 7, No. 2, p 111-119, 1988. 25 ref.

Descriptors: *Water quality management, *Regulations, *Oil industry, *Gas industry, *Environmental protection, Drilling, Environmental policy, Economic aspects, Risks, Hazards, Legal aspects, Waste management.

As environmental regulatory programs complete the initial process of imposing regulatory requirements on large, fixed sources, attention is being focused on the oil and gas drilling and production industry. This effort is presenting challenges to both the regulators and the regulated as ways are sought to incorporate such a diverse industry into regulatory programs that are largely based on uniform national requirements. This is a matter of special concern to the Appalachian oil and gas industry which is characterized by a great many wells producing relatively small amounts of oil and gas. The complexity of regulating waste management in the oil and gas industry is largely a function of trying to fit this multi-faceted, highly mobile industry into regulatory programs which are better suited to the regulation of larger, more permanent sources. Since old regulatory solutions cannot be applied to this problem, many new and innovative regulatory concepts are currently being explored by regulatory agencies and the industry. The common thread in these initiatives seems to be the establishment of programs with enough flexibility to strike that careful balance that is needed between the protection of the environment and the economic viability of an industry that is of great significance both regionally and nationally. The effort being undertaken by EPA to examine the industry from the standpoint of the federal hazardous waste law is clearly one that has the potential for a devastating impact. (White-Reimer-PTT)
W89-10643

IMPACT ASSESSMENT OF ACID DEPOSITION CONTROL BILLS: AN EVALUATION OF SELECTED MODELS,
Cincinnati Univ., OH. School of Planning.
For primary bibliographic entry see Field 5B.
W89-10700

QUALITY ASSURANCE PROGRAMME FOR HYDROMETRIC DATA IN NEW ZEALAND,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 7B.
W89-10763

RIVER BASIN PROJECTS IN AFRICA,
California Inst. of Tech., Pasadena. Inst. for Development Anthropology.
For primary bibliographic entry see Field 6G.
W89-10827

INSTITUTIONAL ASPECTS OF LAKE MANAGEMENT,
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 2H.
W89-10845

ACID RAIN: THE EMERGING LEGAL FRAMEWORK,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W89-10966

LEGAL ASPECTS OF THE SOURCE-RECEPTOR RELATIONSHIP: AN AGENCY PERSPECTIVE,
Environmental Protection Agency, Washington, DC. Air and Radiation Div.
For primary bibliographic entry see Field 5B.
W89-10967

SCIENTIFIC UNCERTAINTY, AGENCY INACTION, AND THE COURTS,
New York State Dept. of Law, Albany.
D. R. Wooley.
IN: Acid Rain: The Relationship between Sources and Receptors. Elsevier Science Publishers, New York. 1988. p 45-55.

Descriptors: *Air pollution control, *Uncertainty, *Administrative agencies, *Judicial decisions, *Environmental policy, *Legislation, *Acid rain, *Water pollution control, Clean Air Act, Regulations, Water pollution sources, Federal jurisdiction.

States and citizen groups are using court actions to force the federal government to act on the problem of acid rain. The uncertainty in the science of source-receptor relationships is being used by the agency to resist demands for action and to obscure EPA's obligations under existing law. Courts, however, generally will not excuse failure to carry out statutory commands on this basis. The Clean Air Act contemplates that decision making necessary to protect health and the environment will often have to be carried out in the face of uncertainty about causes and effects. Acid rain legislation pending in Congress takes this same approach. Certainty in the science of source receptor relationships is largely unattainable. What is attainable, and fairly likely in the near future, is the imposition of acid rain abatement requirements by Congress or the courts. Government and private research efforts should be oriented to that reality. Attempts to delay agency action should be abandoned in favor of an immediate effort to identify a solution based on the best available data and analytical tools. (See also W89-10965) (Author's abstract)
W89-10968

6G. Ecologic Impact Of Water Development

AVIAN COMMUNITY CHANGES FOLLOWING LOWER GRANITE DAM CONSTRUCTION ON THE SNAKE RIVER, WASHINGTON,
Idaho Univ., Moscow. Dept. of Fish and Wildlife Resources.
M. J. Monda, and J. D. Reichel.
Northwest Science NOSCAX, Vol. 63, No. 1, p 13-18, February 1989. 2 fig, 1 tab, 15 ref.

Descriptors: *Dam effects, *Riparian land, *Birds, *Wildlife habitats, *Flood plains, Environmental effects, River flow, Reservoirs, Population density, Aquatic habitats, Washington.

The reservoir behind the Lower Granite Dam on the Snake River inundated 210 hectares of riparian habitat and 1109 hectares of flood plain habitat. Loss of these habitats was associated with the change from free-flowing river to reservoir. A study was performed to evaluate responses of the avian community to habitat change. The numbers of birds and species observed during monthly road counts in 1973 (preimpoundment) were compared to those observed in 1981 (post impoundment). More individual birds and species per survey were observed in 1981. Of 37 species classified as riparian, 18 had a larger number of individuals observed in 1981. The data suggest that some riparian species shifted habitat-use patterns after impoundment, and/or that nonriparian upland habitats were not adequately surveyed prior to impoundment. Riparian passerines decreased after impoundment in number of individuals and species per survey, and

may not have been dependent on riparian habitat. More individuals and eight new species of aquatic birds were recorded in 1981. Migrant ducks during spring contributed heavily to the increase in aquatic birds. The proportion of total birds observed increased for aquatic and upland birds and decreased for riparian birds. These changes paralleled changes in habitat behind the dam. This study may aid in evaluating environmental impacts caused by impoundments. (Author's abstract)
W89-10661

ECOLOGICAL IMPACTS OF INTER-BASIN WATER TRANSFERS: SOME CASE STUDIES, RESEARCH REQUIREMENTS AND ASSESSMENT PROCEDURES IN SOUTHERN AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
M. O. G. Petitjean, and B. R. Davies.
South African Journal of Science SAJSAR, Vol. 84, No. 10, p 819-828, October 1988. 6 fig, 1 tab, 88 ref.

Descriptors: *Africa, *Interbasin transfers, *Management planning, *Environmental effects, Spatial distribution, South Africa, Lesotho, Environmental impact statement, Case studies, Management planning.

Water resources in South Africa are unevenly distributed, with one-third of the country yielding 1% of the total runoff; rainfall is almost invariably either equal to or less than potential evapotranspiration. 'Inter-basin Transfer' (IBT) has been developed to overcome supply problems throughout the country. As demand in donor basins increases, conflict will arise, both provincially and internationally, depending on the size and type of scheme involved. Existing water transfer schemes in Southern Africa presently divert 1.63 billion cu m/yr. This will rise to 4.82 billion cu m/yr (8.9% of the total annual runoff) when all schemes that are planned or under construction come on stream. Four Southern African IBT schemes (Orange River Project, Tugela-Vaal Scheme, Eastern National Water Carrier, and Lesotho Highlands Scheme) are considered as case histories and are described here to highlight some of the problems that such water resource projects engender. All schemes presently operating in South Africa were planned without any form of comprehensive environmental/ecological impact assessment due primarily to the fact that it is only in more recent years that the damage caused by such projects has become apparent. It is suggested that all water projects carried out by any organization should be subject to compulsory environmental impact assessment, that is, an objective, multidisciplinary (including ecological) assessment of all potential short--and long-term impacts of the proposed project, including an assessment of alternatives (eg, IBT versus water recycling) and alternative sites, before detailed planning can proceed. Environmental impact assessments should include consideration of the physico-chemical, biological, and human (economic, social, and cultural) consequences of the proposed IBT. (Rochester-PTT)
W89-10769

EVALUATING CUMULATIVE EFFECTS ON WETLAND FUNCTIONS: A CONCEPTUAL OVERVIEW AND GENERIC FRAMEWORK,
Corvallis Environmental Research Lab., OR.
E. M. Preston, and B. L. Bedford.
Environmental Management EMNGDC, Vol. 12, No. 5, p 565-583, September 1988. 2 fig, 80 ref.

Descriptors: *Wetlands, *Management planning, *Environmental effects, *Research priorities, Landscape functions, Flood-control storage, Water quality, Sediments, Hydrological regime.

Issues that must be confronted in developing a sound scientific basis for investigating cumulative effects on freshwater wetlands are outlined. The foundation is laid for a research program to develop methods to quantify cumulative effects of wetland loss or degradation on the functioning of interacting systems of wetlands: (1) the concept of cumulative effects is defined in terms that permit scientific investigation of effects; (2) the scientific component of cumulative impact analysis is distinguished from other aspects of the assessment process; (3) critical scientific issues in assessing cumulative effects on wetlands are defined; and (4) a hypothetical and generic structure is set up for measuring cumulative effects on the functioning of wetlands as landscape systems. A generic framework is provided for evaluating cumulative effects on three basic wetland landscape functions: flood storage, water quality, and life support. The contribution of a particular wetland to landscape function within watersheds or regions will be determined by its intrinsic characteristics, e.g., size, morphometry, type, percent organic matter in the sediments, and hydrologic regime, and by extrinsic factors, i.e., the wetland's context in the landscape mosaic. The time scales of recovery for processes controlling particular wetland functions determine temporal boundaries. Landscape-level measures are proposed for each function. (See W89-10771 thru W89-10783) (Author's abstract)
W89-10770

CUMULATIVE IMPACTS ON WETLANDS: LINKING SCIENTIFIC ASSESSMENTS AND REGULATORY ALTERNATIVES,
Environmental Protection Agency, Washington, DC. Office of Wetlands Protection.
L. C. Lee, and J. G. Gosselink.
Environmental Management EMNGDC, Vol. 12, No. 5, p 591-602, September 1988. 9 fig, 1 tab, 24 ref.

Descriptors: *Wetlands, *Management planning, *Bottomland, Forests, *Environmental effects, *Regulations, Surveys, Permits, Legal aspects, Landscape functions, Data collections, Watershed management.

The conceptual overview and generic framework for evaluating cumulative effects on wetland functions is extended and applied to bottomland hardwood (BLH) forests of the southeastern United States. Present regulatory procedures are ineffective in preventing incremental forest loss because of the focus on permit-site evaluation, rather than on large landscapes. Spatial and temporal scales are of particular concern for landscape impact assessment. Linking technical information concerning cumulative effects on landscapes to the evaluation of cumulative impacts in regulatory programs (i.e., goal-setting) is a serious issue that can benefit from precedents found in the field of epidemiology, and in the establishment of clean air and clean water standards. Reference data sets must be developed, relating BLH function to structure (forest area). These can be used to set goals for individual watersheds, based on their present conditions and the magnitude and type of perceived development pressures. Thus the crucial steps in establishing a successful program appear to be (1) establish study unit boundaries, (2) assess the condition of study unit landscape integrity, (3) set goals, and (4) consider the impacts of permit proposals with both goals and the existing condition of the study unit landscape in mind. (See W89-10770 and W89-10772 thru W89-10783) (Author's abstract)
W89-10771

CONCEPTUAL FRAMEWORK FOR ASSESSING CUMULATIVE IMPACTS ON THE HYDROLOGY OF NONTIDAL WETLANDS,
Syracuse Univ., NY. Dept. of Geology.
T. C. Winter.
Environmental Management EMNGDC, Vol. 12, No. 5, p 605-620, September 1988. 8 fig, 1 tab, 35 ref.

Descriptors: *Wetlands, *Hydrology, *Environmental policy, Surveys, Surface water, Groundwater movement, Weather modification, Road construction, Drainage, Groundwater recharge, Landscape functions.

Regional slope, local relief, and permeability of the land surface are major controls on the formation of wetlands by surface-water sources. However, these landscape features also have significant control over groundwater flow systems, which commonly play a role in the formation of wetlands. Because the hydrologic system is a continuum, any modification of one component will have an effect on contiguous components. Disturbances commonly affecting the hydrologic system as it relates to wetlands include weather modification, alteration of plant communities, storage of surface water, road construction, drainage of surface and soil water, alteration of groundwater recharge and discharge areas, and pumping of groundwater. Assessments of the cumulative effects of one or more of these disturbances on the hydrologic system as related to wetlands must take into account uncertainty in the measurements and in the assumptions that are made in hydrologic studies. For example, it may be appropriate to assume that regional groundwater flow systems are recharged in uplands and discharged in lowlands. However, a similar assumption commonly does not apply on a local scale, because of the spatial and temporal dynamics of groundwater recharge. Lack of appreciation of such hydrologic factors can lead to misunderstanding of the hydrologic function of wetlands within various parts of the landscape and mismanagement of wetland ecosystems. (See W89-10770 thru W89-10771 and W89-10773 thru W89-10783) (Author's abstract)
W89-10772

EVALUATING CUMULATIVE EFFECTS OF DISTURBANCE ON THE HYDROLOGIC FUNCTION OF BOGS, FENS, AND MIRES,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel.
Environmental Management EMNGDC, Vol. 12, No. 5, p 621-626, September 1988. 3 fig, 1 tab, 46 ref.

Descriptors: *Environmental effects, *Wetlands, *Hydrology, Surveys, Bogs, Fens, Streamflow, Groundwater movement, Evapotranspiration, Water chemistry, Environmental policy.

The current understanding of the hydrologic function of bogs, fens, and mires at different scales and in different physiographic settings is reviewed and hypotheses on potential cumulative impacts on the hydrologic function that might occur with multiple disturbances are presented. It is difficult to evaluate potential cumulative impacts on wetland hydrology because geologic settings of wetlands are often complex and the methods used to measure wetland streamflow, groundwater flow, and evapotranspiration are inexact. This is especially so for bogs, fens, and mires underlain by thick organic soils. These wetlands, found in the circumboreal areas of North America, Europe, are major physiographic features in eastern North America, northern Europe, and Siberia. Few quantitative studies have been done on the hydrology of fens, bogs, and mires. Consequently, predicting the cumulative impacts of disturbances on their hydrologic functions is extremely difficult. Bogs and fens are, in a sense, hydrobiologic systems, and any evaluation of cumulative impacts will have to (1) consider the complicated and little-understood interactions among wetland hydrology, water chemistry, and biota, and (2) place the effect of individual wetland impacts within the context of the cumulative impacts contributed to the watershed from other geomorphic areas and land uses. (See W89-10770 thru W89-10772 and W89-10774 thru W89-10783) (Author's abstract)
W89-10773

EVALUATING THE CUMULATIVE EFFECTS OF ALTERATION ON NEW ENGLAND WETLANDS,
Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien.
Environmental Management EMNGDC, Vol. 12, No. 5, p 627-636, September 1988. 6 fig, 1 tab, 42 ref.

Descriptors: *Rainfall-runoff relationships, *Surface-groundwater relations, *Wetlands, *Hydrology, *Flood peak, *Environmental effects, Surveys, Permeability, Streamflow, Aquifers, Model studies, Geologic formations, Topography.

In New England, patterns of glacial deposition strongly influence wetland occurrence and function. Many wetlands are associated with permeable deposits and owe their existence to groundwater discharge. Whether developed on deposits of high or low permeability, wetlands are often associated with streams and appear to play an important role in controlling and modifying streamflow. Some wetlands may operate to lessen flood peaks, and may have the seasonal effect of increasing spring discharges and depressing low flows. Wetlands overlying permeable deposits may be associated with important aquifers where they can produce slight modifications in water quality and head distribution within the aquifer. Impacts to wetlands undoubtedly will affect these functions, but the precise nature of the effect is difficult to predict. Additional research is needed before hydrologic function can be reliably correlated with physical properties of wetlands and landscapes. A model is proposed to structure future research and explore relationships between hydrologic function and physical properties of wetlands and landscapes. The model considers (1) the nature of the underlying deposits (geologic type), (2) location in the drainage basin (topographic position), (3) relationship to the principal zone of saturation (hydrologic position), and (4) hydrologic character of the organic deposit. (See W89-10770 thru W89-10773 and W89-10775 thru W89-10783) (Author's abstract)
W89-10774

CUMULATIVE IMPACTS ON WATER QUALITY FUNCTIONS OF WETLANDS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemont, and J. Benoit.
Environmental Management EMNGDC, Vol. 12, No. 5, p 639-653, September 1988. 109 ref.

Descriptors: *Wetlands, *Water quality, *Environmental effects, Environmental policy, Cumulative impacts, Chemical properties, Physical properties, Biological properties.

The total effect of cumulative impacts on the water-quality functions of wetlands cannot be predicted from the sum of the effects each individual impact would have by itself. The wetland is not a simple filter; it embodies chemical, physical, and biotic processes that can detain, transform, release, or produce a wide variety of substances. Because wetland water-quality functions result from the operation of many individual, distinct, and quite dissimilar mechanisms, it is necessary to consider the nature of each individual process. Sound knowledge of the various wetland processes is needed to make guided judgments about the probable effects of a given suite of impacts. Consideration of these processes suggests that many common wetland alterations probably do entail cumulative impact. In addition to traditional assessment methods, the wetland manager may need to obtain appropriate field measurements of water-quality-related parameters at specific sites; such data can aid in predicting the effects of cumulative impact or assessing the results of past wetland management. (See W89-10770 thru W89-10774 and W89-10776 thru W89-10783) (Author's abstract)
W89-10775

STRATEGIES FOR ASSESSING THE CUMULATIVE EFFECTS OF WETLAND ALTERATION ON WATER QUALITY,
East Carolina Univ., Greenville, NC. Dept. of Biology.
M. M. Brinson.
Environmental Management EMNGDC, Vol. 12, No. 5, p 655-662, September 1988. 3 fig, 32 ref.

Descriptors: *Environmental effects, *Wetlands, *Water quality, Watersheds, Environmental policy, Environmental protection, Hydrologic data collections, Landscape functions, Aerial photography, Sediments, Deposition.

Assessment of cumulative impacts on wetlands can benefit by recognizing three fundamental wetland categories: basin, riverine, and fringe. The relative proportion of these wetland types within a watershed, and their status relative to past impacts can be used to develop strategies for wetland protection. Past impacts on wetlands, however, are not likely to be clearly revealed in water-quality records from monitoring studies, either because records are too short or because too many variables other than wetland impacts affect water quality. Hydrologic records could be used to reconstruct historical hydroperiods in wetlands for comparison with current, altered conditions. Changes in hydroperiod imply changes in wetland function, especially for biogeochemical processes in sediments. Hydroperiod is potentially a more sensitive index of wetland function than surface areas obtained from aerial photographs; identification of forested wetlands through photointerpretation relies on vegetation that may remain intact for decades after drainage. Finally, the depositional environment of wetlands is a landscape characteristic that has not been carefully evaluated nor fully appreciated. Impacts that reverse depositional tendencies also may accelerate rates of change, causing wetlands to be large net exporters rather than modest importers. (See W89-10770 thru W89-10775 and W89-10777 thru W89-10783) (Author's abstract)
W89-10776

IMPACTS OF FRESHWATER WETLANDS ON WATER QUALITY: A LANDSCAPE PERSPECTIVE,
Smithsonian Environmental Research Center, Edgewater, MD.
D. F. Whigham, C. Chitterling, and B. Palmer.
Environmental Management EMNGDC, Vol. 12, No. 5, p 663-671, September 1988. 3 fig, 55 ref.
NSF and Smithsonian Institution's Environmental Sciences Program Grants DEB-79-11563 and DEB-82-07212.

Descriptors: *Environmental effects, *Wetlands, *Water quality, *Landscape functions, Watersheds, Nitrogen cycle, Phosphorus, Particle size, River systems, Lentic environment, Maryland.

A landscape approach might be useful in evaluating the effects of cumulative impacts on freshwater wetlands. The reason for using this approach is that most watersheds contain more than one wetland, and effects on water quality depend on the types of wetlands and their position in the landscape. Riparian areas that border uplands appear to be important sites for nitrogen processing and retention of large sediment particles. Fine particles associated with high concentrations of phosphorus are retained in downstream wetlands, where flow rates are slowed and where the surface water passes through plant litter. Riverine systems also may play an important role in processing nutrients, primarily during floods. Lacustrine wetlands appear to have the least impact on water quality, due to the small ratio of vegetated surface to open water. Examples are given of changes that occurred when the hydrology of a Maryland floodplain was altered. (See W89-10770 thru W89-10776 and W89-10778 thru W89-10783) (Author's abstract)
W89-10777

NATURE OF CUMULATIVE IMPACTS ON BIOTIC DIVERSITY OF WETLAND VERTEBRATES,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
L. D. Harris.
Environmental Management EMNGDC, Vol. 12, No. 5, p 675-693, September 1988. 7 fig, 2 tab, 108 ref.

Descriptors: *Wetlands, *Animal populations, *Species diversity, *Environmental effects, Cumulative impacts, Aquatic habitats, Lentic environment, Food chains, Vertebrates, Waterfowl, Landscape functions, Wildlife habitats.

There is no longer any doubt that cumulative impacts have important effects on wetland vertebrates. Various examples show how wetlands maintain the biotic diversity within and among vertebrate populations, and some of the ways that environmental perturbations can interact to reduce this diversity. The trophic and habitat pyramids are useful organizing concepts. The complexity of trophic interactions and the propensity, or necessity, of vertebrates to switch from one food source to another--something we know little about--makes using food-chain support as a variable for predicting environmental impacts very questionable. Historical instances illustrate the effects of the accumulation of impacts on vertebrates. One case in point is waterfowl; while their ingestion of lead shot, harvesting by hunters during migration, and loss of habitat have caused waterfowl populations to decline, the proportional responsibility of these factors has not been determined. Further examples show multiplicative effects of similar actions, effects with long time lags, diffuse processes in the landscape that may have concentrated effects on a component subsystem, and a variety of other interactions of increasing complexity. A system of replicate wetland reserves that are allowed to interact naturally with the surrounding landscape will be more effective in preserving biotic diversity than isolated sanctuaries. (See W89-10770 thru W89-10777 and W89-10779 thru W89-10783) (Author's abstract)
W89-10778

ISSUES AND APPROACHES IN ASSESSING CUMULATIVE IMPACTS ON WATERBIRD HABITAT IN WETLANDS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
M. W. Weller.
Environmental Management EMNGDC, Vol. 12, No. 5, p 695-701, September 1988. 5 fig, 38 ref.

Descriptors: *Wetlands, *Wildlife habitats, *Environmental effects, *Water birds, *Cumulative impacts, Surveys, Nutrients, Bioindicators, Vertebrates, Birds, Population dynamics, Research priorities.

Wetlands are attractive to vertebrates because of their abundant nutrient resources and habitat diversity. Because they are conspicuous, vertebrates, notably birds, commonly are used as indicators of changes in wetlands produced by environmental impacts. Such impacts take place at the landscape level where extensive areas are lost; at the wetland-complex level where some (usually small) units of a closely-spaced group of wetlands are drained or modified; or at the level of the individual wetland through modification or fragmentation that impacts its habitat value. Vertebrates utilize habitats differently according to age, sex, geographic location, and season, and habitat evaluations based on isolated observations can be biased. Current wetland evaluation systems incorporate wildlife habitat as a major feature, and the habitat evaluation procedure focuses only on habitat. Several approaches for estimating bird-habitat losses are derived from population curves based on natural and experimentally-induced population fluctuations. Additional research needs and experimental approaches are identified for addressing cumulative impacts on wildlife-habitat values. (See W89-10770 thru W89-10778 and W89-10780 thru W89-10783) (Author's abstract)
W89-10779

SOME THOUGHTS ON USING A LANDSCAPE FRAMEWORK TO ADDRESS CUMULATIVE IMPACTS ON WETLAND FOOD CHAIN SUPPORT,
Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
J. M. Klopatek.
Environmental Management EMNGDC, Vol. 12, No. 5, p 703-711, September 1988. 4 fig, 61 ref.

Descriptors: *Wetlands, *Environmental effects, *Landscape functions, *Food chains, Primary productivity, Habitats, Ecotypes, Land classification, Cumulative impacts, Model studies.

Primary production may not be the measurement that best evaluates food-chain support. Environmental constructs of the wetland and resultant habitat variables appear to yield more information on life-support functions. A landscape-oriented ap-

proach is derived to separate the wetlands hierarchically into ecological regions and landscape elements. This classification scheme allows for predetermination of environmental constraints and the possible natural limits of wetland food-chain support. Models derived from spatial-location theory can be used to determine the movement of animals from wetland patches experiencing impacts on food-chain support. Patch size, distance between patches, habitat diversity, and environmental constraints are incorporated in these models. (See W89-10770 thru W89-10779 and W89-10781 thru W89-10783) (Author's abstract)
W89-10780

REGULATORY CONTEXT FOR CUMULATIVE IMPACT RESEARCH,
Dynamac Corp., Rockville, MD.
A. Hirsch.
Environmental Management EMNGDC, Vol. 12, No. 5, p 715-723, September 1988. 27 ref.

Descriptors: *Environmental effects, *Legal aspects, *Regulations, *Wetlands, Clean Water Act, Cumulative impacts, Environmental protection, Development, Decision making, Permits, Research priorities, Optimum development plans, Information exchange, Case studies.

Wetlands protection has become a topic of increased public attention and support, and regulation of wetlands loss under Section 404 of the Clean Water Act has received high priority within the Environmental Protection Agency (EPA). Despite this, the nation is continuing to experience serious wetlands losses. This situation reflects the contentious nature of wetlands protection; it involves fundamental conflicts between environmental and development interests. Better information is needed to support regulatory decision making, including information on cumulative impacts. Currently, consideration of cumulative impacts, although required by various federal regulations, is limited. An anticipatory, planning-oriented permit-review program is needed to support more effective consideration of cumulative impacts; such an effort is beginning to emerge. In addition, EPA is supporting research to provide better information on the cumulative effects. It is recommended that the EPA program place initial emphasis on synthesis and analysis of existing information, on maximizing its use in decision making, and on information transfer. Recommended approaches include correlation of historic wetlands losses with loss of wetlands function and values, regional case studies, and development of indices of cumulative impact for use in permit review. (See W89-10770 thru W89-10780 and W89-10782 thru W89-10782) (Author's abstract)
W89-10781

EVALUATION PARADIGM FOR CUMULATIVE IMPACT ANALYSIS,
Institute for Water Resources (Army), Fort Belvoir, VA.
E. Z. Stakhiv.
Environmental Management EMNGDC, Vol. 12, No. 5, p 725-748, September 1988. 9 fig, 2 tab, 69 ref.

Descriptors: *Environmental effects, *Cumulative impacts, *Environmental policy, *Model studies, Decision making, Regulations, Permits, Comprehensive planning, Ecological effects.

Cumulative impact analysis is examined from a conceptual decision-making perspective, focusing on its implicit and explicit purposes as suggested within the policy and procedures for environmental-impact analysis of the National Environmental Policy Act of 1969 (NEPA) and implementing regulations. It is also linked to different evaluation and decision-making conventions, in which a regulatory context is contrasted with a comprehensive planning framework. The relatively-familiar Army Corps of Engineers' permit program, in conjunction with the Environmental Protection Agency's responsibilities in managing its share of the Section 404 regulatory program requirements, is used throughout as the realistic context for highlighting certain pragmatic evaluation aspects of cumulative impact assessment. To understand the purposes of cumulative-impact analysis (CIA), a key distinction must be made between the implied comprehensive and multiobjective evaluation purposes of CIA, promoted through the principles and policies contained in the NEPA, and the more commonly conducted and limited assessment of cumulative effects, which focuses largely on the ecological effects of human actions. A heuristic model that incorporates the basic elements of CIA is developed, including the idea of tradeoffs among social, economic, and environmental-protection goals carried out within the context of environmental carrying capacity. (See W89-10770 thru W89-10781 and W89-10783) (Author's abstract)
W89-10782

DEVELOPING THE SCIENTIFIC BASIS FOR ASSESSING CUMULATIVE EFFECTS OF WETLAND LOSS AND DEGRADATION ON LANDSCAPE FUNCTIONS: STATUS, PERSPECTIVES, AND PROSPECTS,
Cornell Univ., Ithaca, NY. Ecosystems Research Center.
B. L. Bedford, and E. M. Preston.
Environmental Management EMNGDC, Vol. 12, No. 5, p 751-771, September 1988. 3 fig, 2 tab, 103 ref.

Descriptors: *Wetlands, *Comprehensive planning, *Reviews, *Environmental effects, Cumulative impacts, Landscape functions, Research priorities, Regulations, Synoptic analysis, Data acquisition, Environmental protection.

The incongruity between the regional and national scales at which wetland losses are occurring, and the project-specific scale at which wetlands are regulated and studied, has become obvious. A synthesis is presented of recent efforts by the Environmental Protection Agency and the Ecosystems Research Center at Cornell University to bring wetland science and regulation into alignment with the reality of the cumulative effects of wetland loss and degradation on entire landscapes and regions. It summarizes the status of our present scientific understanding, discusses means by which to actualize the existing potential for matching the scales of research and regulation with the scales at which effects are observed, and provides guidelines for building a stronger scientific base for landscape-level assessments of cumulative effects. It also provides the outlines for a synoptic and qualitative approach to cumulative effects assessment based on a reexamination of the generic assessment framework. A sound scientific basis for regulation will not come merely from acquiring more information on more variables. It will come from recognizing that a perceptual shift to larger temporal, spatial, and organizational scales is overdue. The shift in scale will dictate different--not necessarily more--variables to be measured in future wetland research and considered in wetland regulation. (See W89-10770 thru W89-10782) (Author's abstract)
W89-10783

INVERTEBRATE COMMUNITY IN THE LITTORAL-REGULATED AREA OF A HYDROELECTRIC LAKE-RESERVOIR (LAKE CAMPOTOSTO, CENTRAL ITALY),
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
For primary bibliographic entry see Field 2H.
W89-10794

RIVER BASIN PROJECTS IN AFRICA,
California Inst. of Tech., Pasadena. Inst. for Development Anthropology.
T. Scudder.
Environment ENTVAR, Vol. 31, No. 2, p 4-9, 27-32, March 1989. 35 ref.

Descriptors: *River basin development, *Africa, *Social impact, *Developing countries, *Environmental protection, Water resources development, Planning, Wetlands, Agriculture, Conservation, Administrative agencies, Administrative decisions, Policy making, Dam effects, Flooding, United Nations, Public participation.

Although often perceived as marginal habitats, African river basins and their associated wetlands are highly productive ecosystems. Recent national leaders have continued to place priority on river basin development projects. However, while some developers are concerned conservationists, the relationship between developers and conservationists in Africa has become increasingly combative. A renewed dialogue between developers and conservationists has resulted in the formation of environmental guidelines by a number of bilateral and multiagency donors, but these guidelines are frequently ignored. Meanwhile, both developers and conservationists make misrepresentations that interfere with efforts to assess the advantages and disadvantages of particular projects and programs on a basin-by-basin or case-by-case basis. The resulting adversary relationship does not serve the interests of either environmental management or development. Strategies for the future are discussed, emphasizing cooperation and participation. It is concluded that, if future river basin development projects are to contribute to sustainable development, radical changes in goals, policies, and plans are necessary. (Doria-PTT)
W89-10827

SYNTHETIC REVIEW ON ARRANGEMENT OF COASTAL FACILITIES AND ENVIRONMENTAL ASSESSMENTS (IN JAPANESE),
L. Jong-sup, and C. Sun-duck.
Bulletin of National Fisheries University of Pusan, Vol. 28, No. 1, p 1-10, June 1988. 4 fig, 5 tab, 19 ref. English summary.

Descriptors: *Coastal engineering, *Coastal zone management, *Planning, *Environmental effects, Construction, Numerical analysis, Mathematical models, Model studies.

Environmental assessment procedures pertaining to the construction of coastal facilities are reviewed. Primary and secondary hydraulic environmental factors are discussed. Conservative equations on these physical phenomena were systematized. The classification of coastal facilities by function and design is tabulated. Applications, regions and input parameters are discussed for several numerical methods for analyzing currents, e.g. tidal, density, storm surge. Numerical models for diffusion phenomena include salinity, suspended solids, and heat models. For these models the particular application, region and input parameters are also considered. A flow chart illustrates the steps to be taken to design an optimum arrangement of coastal facilities. (Peters-PTT)
W89-10848

HYDROLOGY AND ECOLOGY OF THE APALACHICOLA RIVER, FLORIDA: A SUMMARY OF THE RIVER QUALITY ASSESSMENT,
Geological Survey, Raleigh, NC. Water Resources Div.
For primary bibliographic entry see Field 5B.
W89-10948

GROUND-WATER MONITORING AT SANTA BARBARA, CALIFORNIA: PHASE 2--EFFECTS OF PUMPING ON WATER LEVELS AND ON WATER QUALITY IN THE SANTA BARBARA GROUND-WATER BASIN,
Geological Survey, San Diego, CA.
For primary bibliographic entry see Field 4B.
W89-10949

DYNAMIC SPATIAL SIMULATION MODEL OF LAND LOSS AND MARSH SUCCESSION IN COASTAL LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W89-10980

CLASS III SURVEY AND TESTING OF CULTURAL RESOURCES IN PROPOSED FLOOD CONTROL SYSTEM RIGHTS-OF-WAY,

SOUTHEASTERN EL PASO, EL PASO COUNTY, TEXAS,
Mariah Associates, Inc., Albuquerque, NM.
A. C. Earls, and D. C. Newton.
Available from the National Technical Information Service, Springfield, VA 22161, as AD-A197 660. Price codes: A06 in paper copy, A01 in microfiche. 1988. 111p, 23 fig, 6 tab, 26 ref, 5 append. Department of the Army Contract DACW477-85-D-0030.

Descriptors: *Flood control, *Texas, *Archaeology, *Water resources development, El Paso, Texas, Social aspects, History, Dating, Surveys, Right-of-way, Rio Grande, On-site tests.

A Class III intensive survey and limited testing was conducted of undisturbed portions of U.S. Army Corps of Engineers proposed flood diversion projects in the southeastern part of El Paso, Texas. The project area is located between the Rio Grande and Interstate 10 in El Paso. The intact portion of the site is potentially eligible to the National Register of Historic places because of the presence of hearths and the possibility for dating associated artifacts. Adverse impacts primarily occurred 3-10 years ago and consisted of blading the hill slope to obtain fill for construction, followed by aeolian and colluvial erosion and some pothunting. These impacts have reduced site integrity to approximately 50% intactness; many of the hearths have lost charcoal, and much of the material is surficial in depth. Testing within the right-of-way described in this report constitutes mitigation of adverse impacts to known surface aspects of the site since it demonstrated paucity of subsurface materials and lack of depositional integrity on hardpan surfaces. Should subsurface materials be encountered during construction, they will require archaeological recording. (Lantz-PTT)
W89-10991

7. RESOURCES DATA

7A. Network Design

ORGANIZATION AND OPERATION OF THE SAVANNAH RIVER PLANT'S GROUNDWATER MONITORING PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
C. M. Olson, and J. D. Heffner.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 72-77, Spring 1989. 5 fig.

Descriptors: *Network design, *Groundwater quality, *Monitoring, Nuclear plants, Computers, Automation, Savannah River Plant, Water quality management.

The Groundwater Monitoring Program at the Savannah River Plant currently consists of more than 700 wells at more than 70 sites, and growth is projected. The organization and operation of the program has been designed to support an active drilling program, the acquisition of a large amount of repetitive data, the generation of numerous reports, associated QA/QC controls, and provision for additional growth. The design is centered around two key features: modular components and computer usage. The modular component concept is an organizational tool that gives one group responsibility for a specific portion of the program. This responsibility includes the operation of its segment and the coordination of operations with the other groups in the program. Computers, the associated software, and a simple set of rules (the sampling guide) enables the program to accommodate large amounts of repetitive data in a timely, uniform manner. Feedback loops are included to ensure that new data are incorporated into future program decisions (new sample schedules and well locations). The highly automated system determines sample schedules, collates/reviews incoming data, and generates various reports. Six reports are issued on a regular basis, from quarterly to annually, to ensure that the program is adequately documented. The program has been in successful operation for over a year and has accommodated the expected growth. (Author's abstract)
W89-10678

LIMITATIONS OF MONITORING WELLS FOR THE DETECTION AND QUANTIFICATION OF PETROLEUM PRODUCTS IN SOILS AND AQUIFERS,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
A. S. Abdul, S. F. Kia, and T. L. Gibson.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 90-99, Spring 1989. 9 fig, 1 tab, 10 ref.

Descriptors: *Network design, *Monitoring wells, *Observation wells, *Oil pollution, *Soil contamination, *Path of pollutants, *Groundwater pollution, *Monitoring, *Aquifers, Wells, Petroleum products, Porous media, Cleanup operations.

Theoretical analysis and laboratory column experiments were carried out to investigate the conditions required for petroleum products (oil) to flow into a well installed through a sandy porous medium contaminated with the oil. The results indicated that oil would flow into a well only after a layer of 'free oil' is formed in the adjacent porous medium. Because significant quantities of oil could be stored in the porous medium under the influence of capillary suction prior to the formation of the zone of free oil, the presence of oil in a well would indicate an advanced stage of oil contamination of the subsurface. While monitoring wells could be used to delineate the extent of the free-oil plume and the plume of dissolved petroleum constituents, they are not useful for delineating the extent of capillary held oil. The results also indicated that the ratio of the oil-layer thickness in the well to that in the porous medium is not a constant as is sometimes assumed in practice. Further, estimates of the oil thickness in the medium based on the oil thickness in the wells and on capillary properties measured in the laboratory were sensitive to the values of the parameters used in these estimates. The measured thickness of the oil layer in a monitoring well alone may not yield reliable estimates of the amount of oil in the substrate, and assuming that the oil-thickness ratio is a constant can lead to inadequate site assessments and inappropriate remedial plans. (Author's abstract)
W89-10681

SAMPLING STRATEGIES FOR WATER QUALITY MONITORING IN LAKES: THE EFFECT OF SAMPLING METHOD,
Freshwater Biological Association, Ambleside (England).
J. Hilton, T. Carrick, E. Rigg, and J. P. Lishman.
Environmental Pollution ENPOEK, Vol. 57, No. 3, p 223-234, 1989. 2 fig, 1 tab, 16 ref.

Descriptors: *Network design, *Data acquisition, *Sampling, *Water quality, *Monitoring, *Lakes, Nutrients, Hypolimnion, Epilimnion, Boats, Standard deviation, Ammonia, Temperature, Oxygen.

Five different water sampling techniques were compared in a series of lakes in the English Lake District. In deep lakes, no significant differences were observed between mean summer nutrient concentrations measured in (1) a tube sample integrating over the photic zone taken from the deepest point; (2) a surface dip sample taken at the deepest point; (3) a surface dip sample taken by wading into the water's edge; (4) a dip sample taken slightly further off shore; and (5) a sample taken along a short transect out from the shore using a model boat to transport the sample bottle. In shallower lakes, the integrating tube sampler gave significantly higher estimates of mean concentrations than other methods due to the increase in volume of the unmixed hypolimnion which reduced the depth of the well-mixed epilimnion to less than the tube length. For national survey purposes, samples taken from the edge of the lake are the most cost effective. (Author's abstract)
W89-10824

PROGRAM FOR EVALUATING STREAM QUALITY IN NORTH CAROLINA,
Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 5B.
W89-10943

OPTIMAL DESIGN OF PIPE NETWORKS: A REVIEW,
Exeter Univ. (England). Dept. of Engineering Science.
For primary bibliographic entry see Field 5F.
W89-11035

MATHEMATICAL MODELING FOR OCEAN AND COASTAL WATERS,
Hanover Univ. (Germany, F.R.). Inst. fuer Stroemungsmechanik und Elektronisches Rechnen im Bauwesen.
For primary bibliographic entry see Field 2L.
W89-11058

7B. Data Acquisition

BACTERIVORY BY BENTHIC CILIATES: SIGNIFICANCE AS A CARBON SOURCE AND IMPACT ON SEDIMENT BACTERIA,
Brookhaven National Lab., Upton, NY.
For primary bibliographic entry see Field 2H.
W89-10542

BIOASSAY METHODS FOR EVALUATING THE TOXICITY OF HEAVY METALS, BIOCIDES AND SEWAGE EFFLUENT USING MICROSCOPIC STAGES OF GIANT KELP MACROCYSTIS PYRIFERA (AGARDH): A PRELIMINARY REPORT,
California Univ., Santa Cruz. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5A.
W89-10548

ACUTE TOXICITY OF INTERSTITIAL AND PARTICLE-BOUND CADMIUM TO A MARINE INFAUNAL AMPHIPOD,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 5C.
W89-10549

IMPROVED INTERLABORATORY COMPARISONS OF POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE SEDIMENT,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5A.
W89-10551

SLOPING CREST CRUMP WEIR,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. J. Keller.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 231-238, April 1989. 4 fig, 1 tab, 8 ref.

Descriptors: *Weirs, *Flow measurement, *Gaging, *Hydraulic models, Model studies, Crump weirs, Calibrations.

A hydraulic model study of an existing sloping crest Crump weir is described. Two models of scales 1:10 and 1:3 were tested. At relatively large heads, the structure behaves as one half of a flat-V Crump weir with the same transverse crest slope. At lower heads, the flow cross section becomes strongly non-symmetrical with a consequent significant decrease in the value of the discharge coefficient. The critical head at which departure from a constant discharge coefficient commences is sensitive to the extent of upstream sedimentation in the channel. The sloping crest Crump weir should not be used for flow measurement in a straight channel without an associated model study or an extensive field calibration. (Author's abstract)
W89-10559

PHOTO-OXIDATION OF DISSOLVED ORGANIC MATTER FOR TRACE METAL ANALYSIS,
North Carolina Univ., Chapel Hill. School of Public Health.
M. Martin-Goldberg, and M. S. Shuman.

Chemical Speciation and Bioavailability, Vol. 1, No. 1, p 19-23, April 1989. 4 fig, 14 ref.

Descriptors: *Water analysis, *Coastal waters, *Photo oxidation, *Trace metals, Testing procedures, Ultraviolet irradiation, Fulvic acids, Saline water, Carbon, Natural waters, Fluorescence, Chemical degration, Georgia, *Dissolved organic matter.

Prior to the analysis of trace metals in natural waters, dissolved organic matter (DOM) must be destroyed without the introduction of metal contamination. Two stations in the Georgia Bight were sampled at a depth of .5 m. The samples were irradiated in two UV chambers, one containing a 14 W mercury arc lamp and the second with a 1000 W arc lamp. Photo-oxidation significantly reduces the concentration of DOM, but does not totally remove it from solution. Measurement of the fluorescence intensity of acidified samples is a simple method to monitor the degradation of fulvic acids at carbon concentrations as low as 0.005 mg C/L. In saline solutions, removal of DOM is more complete with a 14 W fluorescent lamp than with a 1000 W lamp, and with H202 than with HNO3 as the oxidant. In non-saline solutions, no difference is observed between lamps or between oxidants. In all cases, removal of DOM is more complete in non-saline than in saline solutions. A review of photo-degradation mechanisms suggest that OH is largely responsible for fulvic acid degradation and that the reaction proceeds by an auto-oxidation mechanism. (White-Reimer-PTT)
W89-10636

SHOULD WE USE A WELL FOOT (SEDIMENT TRAP) IN MONITORING WELLS,
For primary bibliographic entry see Field 8G.
W89-10676

APPLICATIONS OF DUAL-WALL REVERSE-CIRCULATION DRILLING IN GROUND WATER EXPLORATION AND MONITORING,
Hart Environmental Management Corp., Irvine, CA.
M. F. Strauss, S. L. Storey, and N. E. Mehlhorn.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 63-71, Spring 1989. 7 fig, 1 ref.

Descriptors: *Drilling, *Groundwater, *Exploration, *Groundwater quality, *Monitoring, *Boreholes, *Wells, Percussion hammer system, Landfills, Case studies.

Dual-well reverse-circulation drilling uses flush-threaded double-wall drill pipe and high-pressure air to provide continuous return of formation and water samples. Cuttings and formation waters are not contaminated with drilling additives or mixed with other borehole material. Up-hole velocity of about 70 ft/sec provides reliable logging of water, mineral or contaminant-bearing strata. Water samples representative of specific strata may be airlifted or bailed to the surface. In the percussion hammer system, dual-wall drill pipe is advanced through chiefly unconsolidated material by the percussion action of an aboveground pile hammer. The borehole is drilled and temporarily cased in one pass. Wells or monitoring devices are installed as the pipe drill is hydraulically retracted during construction. A rotary head may be adapted as an option to allow dual-wall rotary drilling into consolidated or crystalline formations through a percussion hammer drill string temporarily left in place as a conductor. The complex geology and variety of geoenvironmental problems in southern California has provided a testing ground for dual-wall drilling on hazardous material site investigations. Several case histories have demonstrated the capabilities and versatility of this method, including: (1) the installation of 4-inch and 6-inch diameter gasoline monitoring and recovery wells through gravels and cobbles at a filling station where hollow-stem auger drilling failed; (2) the confirmation of a dry borehole initially drilled by direct rotary at a landfill; and (3) multiple installations of monitoring devices through municipal refuse at a Los Angeles landfill. (Author's abstract)
W89-10677

TRACER TEST FOR DETECTING CROSS CONTAMINATION ALONG A MONITORING WELL COLUMN,
EBASCO Services, Inc., Chicago, IL.
For primary bibliographic entry see Field 5A.
W89-10679

EQUIPMENT DECONTAMINATION PROCEDURES FOR GROUND WATER AND VADOSE ZONE MONITORING PROGRAMS: STATUS AND PROSPECTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5A.
W89-10682

EFFECT OF AMMONIA ON COD ANALYSIS,
General Motors Research Labs., Warren, MI.
B. R. Kim.
Journal--Water Pollution Control Federation JWPFA5, Vol. 61, No. 5, p 614-617, May 1989. 3 fig, 1 tab, 4 ref.

Descriptors: *Wastewater analysis, *Chemical oxygen demand, *Ammonia, Organic wastes, Concentration time, Digestion, Chlorides.

Chemical oxygen demand (COD) is used as a measure of the organic content of wastewater. Interference of ammonia with COD analysis was observed when chloride was present and when a 0.25-N potassium dichromate solution was used to prepare the COD vials. The interference increased with increases in both ammonia and concentration and digestion time. The interference was not observed when COD analysis was performed with the COD vials prepared with a 0.025-N potassium dichromate solution, or when chloride was absent. (Author's abstract)
W89-10695

QUANTITATIVE ANALYSIS OF SOLUBILIZED METHANE IN REFUSE LEACHATE,
University of Strathclyde, Glasgow (Scotland). Dept. of Bioscience and Biotechnology.
For primary bibliographic entry see Field 5A.
W89-10703

ALTERNATIVE APPROACH TO THE YEAST EXTRACT-NALIDIXIC ACID METHOD FOR DETERMINING THE PROPORTION OF METABOLICALLY ACTIVE AQUATIC BACTERIA,
Hull Univ. (England). Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W89-10704

GRANULAR SOILS IN RIGID-WALL PERMEAMETERS: METHOD OF DETERMINING THE DEGREE OF SATURATION,
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 2G.
W89-10748

INEXPENSIVE VIDEO DATA CAPTURE SYSTEM FOR HYDROLOGICAL MAPS,
Institute of Hydrology, Wallingford (England).
R. Gross.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 157-167, April 1989. 6 fig, 7 ref.

Descriptors: *Digital mapping, *Hydrologic maps, *Digitization, *Mapping, *Video, France, Hydrology, Brittany, Soil maps, Performance evaluation.

Digital mapping techniques are being used increasingly in hydrology. One of the constraints on the application of those techniques is the digitizing process, which can be costly and time consuming. The background and development are described of a low-cost, easy-to-use system for digitizing maps. The system is based on the use of a video camera as a scanner. The process of digitizing the hydrological soil map of western Brittany (France) is described as an example of the use of the system. The digitizing hardware is inexpensive and represents a viable low cost alternative to the conventional digitizing methods available. Limitations on accuracy were considered to be: (1) the quality of image capture by the video system, (2) the resolution of the digitized image, (3) the quality of the source maps, and (4) the precision to which the geographical coordinates of points on the source maps can be obtained. The present system is limited to hydrological soil maps consisting of black lines on a white background, but future improvements in equipment and software could enable digitizing of colored maps displaying continuous variables. (Rochester-PTT)
W89-10761

QUALITY ASSURANCE PROGRAMME FOR HYDROMETRIC DATA IN NEW ZEALAND,
Ministry of Works and Development, Wellington (New Zealand).
M. P. Moseley, and A. I. McKerchar.
Hydrological Sciences Journal HSJODN, Vol. 34, No. 2, p 185-202, April 1989. 2 fig, 25 ref.

Descriptors: *New Zealand, *Hydrologic data, *Quality control, *Data acquisition, Standards, National Hydrometric Reference Network, Hydrologic data collections, Management planning, Cost analysis.

The objectives of a National Hydrometric Reference Network for New Zealand are specified, and the necessary standards for data collection are defined. The discussion in this article covers: steps in establishing a quality assurance program; user needs for hydrological information; setting standards; procedures for data collection and archiving; management of the data archive; quality control of the data; and disseminating audit results. Data are collected in New Zealand by several agencies and a data quality assurance program must be designed and administered to take account of this. The program involves a full range of practices, from providing manuals and adequate staff training through to auditing of archived data, and disseminating audit results. it is not a formal program like those used in industrial settings, but it is an effective way of assuring users, at an acceptable cost, that hydrometric data meet the quality standards they require. (Author's abstract)
W89-10763

REMOTE SENSING APPLICATIONS IN WATER RESOURCES PROSPECTING AND MANAGEMENT,
International Bank for Reconstruction and Development, Washington, DC. Water and Telecommunications Div.
S. V. R. Rao.
Resource Management and Optimization RMOPDH, Vol. 6, No. 1, p 35-44, December 1987. 15 ref.

Descriptors: *Remote sensing, *Groundwater management, *Water quality management, *Water resources development, *Satellite technology, Aquifer management, Seepage control, Streamflow, Stream pollution, River flow, Water pollution effects, Pollutant identification, Tracking techniques, Surface water, Monitoring, Automation, Data acquisition.

Remote sensing can be a powerful tool in the years ahead for adequate monitoring of ground and surface freshwater resources and for prospecting of the groundwater resources, so that appropriate management decisions can be made for proper utilization of these resources. Satellite images can provide valuable information with regard to the location of the aquifers, and seepage rates of water from the streams and rivers. Groundwater contamination can also be adequately monitored with satellite imagery. Remote sensing techniques utilizing satellite imageries can be extremely useful for tracking the course of hazardous spills in streams and rivers, which would otherwise not be possible with ground-based measurements. Similarly, remote sensing techniques utilizing satellite imageries can provide continuous monitoring of surface water quality in rivers, streams, and lakes. This has the greatest advantage over the ground-based continuous monitoring with automated instrumentation in being quite inexpensive and in not being

open to interruptions of data acquisition. Satellite imagery can provide accurate information regarding the extent of aquatic growths in rivers and lakes. Satellite imagery can also be useful for mapping the weed beds in rivers and lakes, for making rough approximations of the volume and biomass of aquatic weeds, and for following the spread of nuisance algae in lakes. (Fish-PTT)
W89-10792

METHODS FOR DETERMINING TOXICITY OF POLLUTANTS DISCHARGED INTO WATERS (METODY OKRESLANIA TOKSYCZNOSCI ZANIECZYSZCZEN WPROWADZANYCH DO WOD),
Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 5C.
W89-10806

CONVENIENT TEST METHOD FOR PHOTOCHEMICAL TRANSFORMATION OF POLLUTANTS IN THE AQUATIC ENVIRONMENT,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5A.
W89-10812

DEVELOPING A METHODOLOGY FOR IN SITU MEASUREMENTS OF LOW PERMEABILITY SUITABLE FOR HAZARDOUS-WASTE LANDFILL,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 5E.
W89-10840

RESPIROMETRIC METHOD FOR BIOKINETIC CHARACTERIZATION OF TOXIC WASTES,
Delaware Univ., Newark. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W89-10863

DETERMINATION OF ACETOCLASTIC METHANOGENIC ACTIVITY IN ANAEROBIC SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-10897

NOVEL APPROACH TO SIMPLIFIED RESPIROMETRIC OXYGEN DEMAND DETERMINATIONS,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
F. Cadena, A. Drohobyczer, M. I. Beach, and D. Barnes.
IN: Proceedings of the 43rd Industrial Waste Conference, May 10-12, 1988, Purdue University, West Lafayette, Indiana. Lewis Publishers, Chelsea, Michigan, 1989. p 459-467, 4 fig, 2 tab, 8 ref.

Descriptors: *Oxygen demand, *Respiration, *Measuring instruments, *Water quality control, Pneumatic computerized respirometer, Chemical analysis, Biochemical oxygen demand.

Several accurate manometric devices capable of measuring gas consumption or production by microbial activity were used in the biological sciences laboratories since the turn of the century. Some of these manometers were designed to measure oxygen demand (i.e., respirometers) during microbial respiration. Instruments specifically designed for environmental work have gained wider acceptance. Development of instruments designed primarily for environmental applications, such as the electrolytic respirometer (EBOD) and others, are widely used in engineering research. These devices combine relative operational simplicity with ruggedness and sample representatives. Use of various mechanical recorders or printers simplified data collection in environmental science respirometers. For example, development of the EBOD apparatus at New Mexico State University (NMSU) greatly facilitated data collection. Recent modifications to this instrument eliminate interferences due to barometric pressure variations, and reduce errors created by electrolyte evaporation. Microbial kinetic studies at NMSU required an instrument capable of continuously monitoring oxygen uptake without being affected by several common interferences found in other respirometers. These analytical needs were met by means of the pneumatic computerized respirometer (PCBOD). The PCBOD apparatus introduces two unique features into the field of respirometry: (1) a vacuum switch replaces the conventional U-tube or pressure transducer used by other respirometers; and (2) the oxygen is supplied to the reactor from a regulated (high-pressure) oxygen tank (breathing or welding grade). The PCBOD apparatus is a constant pressure respirometer that eliminates the need for venting, isolates the unit from the atmosphere, and maintains a constant oxygen level in the system. The only moving parts in the instrument are the solenoid valve and the mixer. Analytical work is reduced to addition and removal of the sample and the alkali trap at the beginning and end of a test respectively. The only chemicals required to operate the pCBOD respirometer are a strong alkali, such as KOH or LiOH, and breathing oxygen. The PCBOD precision is significantly superior to that of the open-cell EBOD respirometers tested in long-term studies lasting up to 180 hr. (See also W89-10858) (Lantz-PTT)
W89-10909

ESSENTIAL OF BIOTECHNOLOGY,
Versar, Inc., Springfield, VA.
R. P. Ouellette, and P. N. Cheremisinoff.
Technomic Publishing Co., Inc., Lancaster, PA. 1985. 226 p.

Descriptors: *Biotechnology, *Measuring instruments, *Chemical analysis, *Water properties, Centrifugation, Chromatography, Electrophoresis, Fermentation, Culturing techniques.

Biotechnologies are made possible by the rapid development and utilization of a variety of techniques, methods, instruments and equipment. High speed centrifugation, high pressure chromatography, electrophoresis are the tricks of the trade. Monoclonal antibodies, DNA probes, plasmids, vectors are the tools. Protoplast fusion, Ti plasmids, DNA sequencing techniques, gene synthesizing machines, cell culture, fermentation are all part of this arsenal. The properties of water, with respect to developing biotechnologies is highlighted in this book, along with discussions on the medical and chemical aspects and applications of the technology. (See also W89-10962) (Lantz-PTT)
W89-10960

APPLICATIONS OF BIOTECHNOLOGY,
Versar, Inc., Springfield, VA.
For primary bibliographic entry see Field 5D.
W89-10962

INFORMATION NEEDS-AQUATIC,
New York Botanical Garden, Bronx, NY. Inst. of Ecosystem Studies.
For primary bibliographic entry see Field 5B.
W89-10970

SPATIALLY DISTRIBUTED MODEL OF RAISED BOG RELIEF,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
For primary bibliographic entry see Field 2H.
W89-10977

SIMULATION MODELS OF COASTAL WETLAND AND ESTUARINE SYSTEMS: REALIZATION OF GOALS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 2L.
W89-10979

PRODUCTIVITY-HYDROLOGY-NUTRIENT MODELS OF FORESTED WETLANDS,
Ohio State Univ., Columbus. School of Natural Resources.
For primary bibliographic entry see Field 2H.
W89-10981

FIELD-STUDY DESIGN FOR MODULE EVALUATION: PRECP VI/3CP0,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
For primary bibliographic entry see Field 5B.
W89-11008

MODEL OF ALGERIAN-TUNISIAN CONTINENTAL INTERCONNECTING EXTENDED TO LIBYA (EXTENSION EN LIBYE DU MODELE DU CONTINENTAL INTERCALAIRE ALGERO-TUNISIEN),
Ecole Nationale des Ingenieurs de Tunis (Tunisia).
For primary bibliographic entry see Field 2F.
W89-11018

AQUIFER SIMULATION FOR OPTIMUM WATER YIELD,
Mosul Univ. (Iraq). Coll. of Engineering.
For primary bibliographic entry see Field 4B.
W89-11019

PREDICTING REGIONAL GROUNDWATER LEVELS BY THREE-DIMENSIONAL NUMERICAL MODELS,
Padua Univ. (Italy).
For primary bibliographic entry see Field 4B.
W89-11020

FINITE ELEMENT SIMULATION OF THE HYDROTHERMAL BEHAVIOR OF AN ARTIFICIAL AQUIFER FOR SEASONAL ENERGY STORAGE,
Technische Hochschule Aachen (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W89-11021

TWO-DIMENSIONAL FINITE ELEMENT MODEL FOR SOLUTE TRANSPORT IN MULTI-AQUIFER SYSTEMS,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 2F.
W89-11022

TWO-DIMENSIONAL FINITE ELEMENT MODEL FOR WATER FLOW IN MULTI-AQUIFER SYSTEMS,
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 2F.
W89-11023

FINITE ELEMENT MULTI-LAYER AQUIFER MODEL, 'FEMLAM',
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 2F.
W89-11024

SIMULATION OF REGIONAL SUBSURFACE FLOW BY FINITE ELEMENT MODELS,
Padua Univ. (Italy). Inst. of Applied Mathematics.
For primary bibliographic entry see Field 2F.
W89-11025

SELECTIVE LUMPING EFFECTS ON DEPTH-INTEGRATED FINITE ELEMENT MODEL OF CHANNEL FLOW,
Mississippi Univ., University. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2E.
W89-11026

PARAMETER IDENTIFICATION IN UNSATURATED FLOW AND SOLUTE TRANSPORT MODELS,
Pontificia Univ. Catolica de Chile, Santiago. Faculty of Engineering.
For primary bibliographic entry see Field 2G.
W89-11027

NUMERICAL SIMULATION OF TRANSIENT UNCONFINED SEEPAGE PROBLEMS,
Liege Univ. (Belgium).
For primary bibliographic entry see Field 2F.
W89-11028

FINITE ELEMENT MODEL FOR AQUIFER SIMULATION WITH APPLICATION IN GANGES-KOBADAK PROJECT,
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 2F.
W89-11029

NUMERICAL SIMULATION FOR SALT TRANSPORT IN COASTAL AQUIFERS,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W89-11030

COMPUTER APPLICATION TO GEOELECTRIC EXPLORATION FOR GROUND WATER IN DESERT AREAS,
Zagazig Univ. (Egypt). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W89-11031

7C. Evaluation, Processing and Publication

OPEN CHANNEL FLOW THROUGH TRANSVERSE FLOOR OUTLETS,
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W89-10561

CONTINUOUS DISTRIBUTED MODEL OF STORAGE DOMINATED WATERSHED RUNOFF,
California Univ., Los Angeles.
For primary bibliographic entry see Field 2E.
W89-10564

NONLINEAR SEISMIC ANALYSIS OF ARCH DAMS,
Impell Corp., Walnut Creek, CA.
For primary bibliographic entry see Field 8A.
W89-10573

PREDICTION MODELS OF VARIOUS POLLUTANTS IN THE RIVER TIGRIS AT BAGHDAD,
Baghdad Univ. (Iraq). Coll. of Engineering.
For primary bibliographic entry see Field 5B.
W89-10588

PREDICTION OF THE SOLUBILITY OF HYDROCARBONS IN WATER USING UNIFAC,
Kuwait Univ., Safat. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-10590

RIVER PLANFORM FACIES MODELS: THE SEDIMENTOLOGY OF BRAIDED, WANDERING AND MEANDERING REACHES OF THE SQUAMISH RIVER, BRITISH COLUMBIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-10674

STATISTICAL ESTIMATION OF EXTREME FLOOD FLOWS USING CONFIDENCE INTERVALS,
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 2E.
W89-10687

AUTOMATED DATA MANAGEMENT FOR DAM SAFETY EVALUATIONS,
Corps of Engineers, Washington, DC.
A. H. Walz.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 23-25, April 1989. 2 fig.

Descriptors: *Dam stability, *Dams, *Automation, *Data processing, *Computers, Data collections, Communication, Safety, Sensors, Accelerometers, Piezometers.

Recent developments in the fields of electronics and computing have made it possible to install and operate real time systems for instrumentation data collection and management at multiple dam projects. The US Army Corps of Engineers is midway through a 4-year demonstration program intended to evaluate the dependability, reliability, and compatibility of automated system components, sensors, control units, and communication options. The program is also attempting to determine the best way to automate various types of instruments, e.g. piezometers, accelerographs and sensors for recording seismic events. To date, the results of this program indicate that basic instrumentation can easily be automated with a high degree of confidence. While some minor problems exist in interfacing some sensors with the control units, the commercially available system components are now compatible and produce a reliable system. As of July 1988, 24 major dams in the U.S. have had some or all of their instruments automated. (Author's abstract)
W89-10688

STATISTICS OF DAM FAILURES: A PRELIMINARY REPORT,
Coimbra Univ. (Portugal). Seccao Autonoma de Engenharia Civil.
For primary bibliographic entry see Field 8A.
W89-10690

COMPARISON OF PARAMETERIZED NITRIC ACID RAINOUT RATES USING A COUPLED STOCHASTIC-PHOTOCHEMICAL TROPOSPHERIC MODEL,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 5B.
W89-10701

SULPHUR DIOXIDE AND SULPHATE IN A THREE-DIMENSIONAL FIELD OF CONVECTIVE CLOUDS: NUMERICAL SIMULATIONS,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W89-10710

SIMPLE PARAMETER-FREE FLOOD MAGNITUDE ESTIMATOR,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2E.
W89-10759

EFFECT OF CHOICE OF ROUTING MODEL ON EXTREME FLOW STATISTICS,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
For primary bibliographic entry see Field 2E.
W89-10760

INEXPENSIVE VIDEO DATA CAPTURE SYSTEM FOR HYDROLOGICAL MAPS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W89-10761

WATERSHED SURVEYS TO SUPPORT AN ASSESSMENT OF THE REGIONAL EFFECTS OF ACIDIC DEPOSITION ON SURFACE WATER CHEMISTRY,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W89-10847

QUALITATIVE APPRAISAL OF THE HYDROLOGY OF THE YEMEN ARAB REPUBLIC FROM LANDSAT IMAGES,
M. J. Grolier, G. C. Tibbitts, and M. M. Ibrahim.
Available from Books and Open-File Reports Section, USGS, Box 25425, Denver, CO 80225. USGS Water-Supply Paper 1757-P, 1984. 70p, 7 fig, 3 tab, 1 plate, 38 ref, 3 append.

Descriptors: *Remote sensing, *Data interpretation, *Landsat, *Yemen, *Hydrologic budget, *Hydrologic systems, Satellite technology, Hydrological regime, Groundwater budget, Surface water, Streamflow, Land use, Agriculture.

Landsat 1 and Landsat 2 images were analyzed in June 1976 to describe the flow regimens of streams and the regional distribution of vegetation in the Yemen Arab Republic (YAR). The findings provide a factual basis for planning a surface water data collection program and for preparing maps of plant distribution and agricultural land use. Nine Landsat scenes cover the entire YAR. A false-color, composite mosaic of nine corresponding images was prepared. Catchment areas and the major drainage basins were delineated on this mosaic. A hydrological and ecological analysis of this array of imagery shows many kinds of streamflow regimens and, along the reaches of some streams at least, yearly and seasonal fluctuations or changes in streamflow. Similar fluctuations in soil moisture and possibly in groundwater supply were inferred from variations in the site of vegetated areas and the apparent (spectral) vigor of plant growth. In order of increasing water availability, the four catchment areas of the YAR are: Rub al Khali (Ar Rab al Khali), Wadi Jawf (Arabian Sea), Red Sea, and Gulf of Aden. Most streams are ephemeral. No lakes were detected during the period under investigation, but sebkhas (salt flats or low, salt-encrusted plains) are common along the Red Sea coast. (Lantz-PTT)
W89-10941

FRESHWATER ECOSYSTEMS: MODELLING AND SIMULATION,
Ceskoslovenska Akademie Ved, Ceske Budejovice. Inst. of Landscape Ecology.
For primary bibliographic entry see Field 2H.
W89-10959

SIMULATING SOURCE-RECEPTOR RELATIONSHIPS FOR ATMOSPHERIC CONTAMINANTS,
Michigan Univ., Ann Arbor. Rocket Propulsion Lab.
For primary bibliographic entry see Field 5B.
W89-10971

WETLAND MODELLING.
For primary bibliographic entry see Field 2H.
W89-10975

HYDROLOGIC PROCESSES FOR MODELS OF FRESHWATER WETLANDS,
National Audubon Society, Naples, FL. Ecosystem Research Unit.
For primary bibliographic entry see Field 2H.
W89-10976

INTERFERENCE BETWEEN MOSSES AND TREES IN THE FRAMEWORK OF A DYNAMIC MODEL OF CARBON AND NITROGEN CYCLING IN A MESOTROPHIC BOG ECOSYSTEM,

Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
For primary bibliographic entry see Field 2H.
W89-10978

MODELLING NUTRIENT RETENTION BY A REEDSWAMP AND WET MEADOW IN DENMARK,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 2H.
W89-10982

SOME SIMULATION MODELS FOR WATER QUALITY MANAGEMENT OF SHALLOW LAKES AND RESERVOIRS AND A CONTRIBUTION TO ECOSYSTEM THEORY,
Ceskoslovenska Akademie Ved, Ceske Budejovice. Biomathematical Lab.
For primary bibliographic entry see Field 5G.
W89-10983

MODELLING EUTROPHICATION OF SHALLOW LAKES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Environmental Chemistry.
For primary bibliographic entry see Field 2H.
W89-10984

STATISTICAL TECHNIQUES FOR REGIONAL MODEL EVALUATION,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W89-11009

COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.
For primary bibliographic entry see Field 2F.
W89-11016

GROUNDWATER MODELLING, THREE DIFFERENT APPLICATIONS OF A COMPUTER CODE FOR SIMULATION OF GROUNDWATER FLOW,
VBB/SWECO Consulting Group, Stockholm (Sweden).
For primary bibliographic entry see Field 2F.
W89-11017

SIGNAL PROCESSING IN ACOUSTIC EMISSION BEHAVIOR IN SOILS,
Lublin Technical Univ. (Poland).
For primary bibliographic entry see Field 2G.
W89-11032

COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.
Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. 461 p. Edited by D. Ouazar, C.A. Brebbia and H. Barthet.

Descriptors: *Fluid mechanics, *Model studies, *Hydraulic structures, *Hydraulic engineering, *Pipelines, *Dams, Conveyance structures, Hydrodynamics, Fluid mechanics, Channel flow, Pipe flow, Networks, Flow system, Flow measurment, Hydraulic properties, Conferences.

This volume contains edited papers on computational hydraulics submitted to the First International Conference in Africa on Computer Methods and Water Resources, held in Rabat, Morocco March 14-18th, 1988. Many problems related to flow in networks involve the use of complex computational procedures. Fluid and marine hydraulics phenomena are difficult to model due to the randomness of the processes and sometimes the presence of multiphase flows. Contributions are included on steady hydraulic systems for pipe or channel networks, fluid transients, flood sorting, dambreaking, fluid and marine hydraulics. Some contributions are of direct relevance to the development and optimization of software codes while others describe some available packages and their applications. (See W89-11034 thru W89-11066) (Author's abstract)
W89-11033

SIMNET-MICROCOMPUTER MODELLING OF IRRIGATION, WATER SUPPLY AND WATER DISTRIBUTION SYSTEMS,
City Univ., London (England). Thermo-Fluids Engineering Research Center.
A. R. D. Thorley, and D. J. Wood.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 3-20, 8 fig, 4 tab, 3 ref.

Descriptors: *Model studies, *Water supply, *Water distribution, *Computer models, *Computer programs, *Economic aspects, *Irrigation design, *Water management, Pumps, Algorithms, Reservoir operation, Networks, Cost analysis, Flow rates, Flow profiles.

Accurate calculations of pressure and flow conditions in pipe network systems are required for their efficient and economical design and operation. The required calculations are extensive and it has been recognized for some time that computers are required if these systems are to be engineered and managed properly. A program meeting these requirements, called SIMNET, has several desirable features. Its solution algorithm provides accurate and reliable results without requiring excessive computer memory. The program can handle any network configuration and accommodate a large variety of network components for a wide range of applications. Time simulations take account of storage within the system, variable reservoir and river levels, fluctuations in demand and the starting and stopping of pumps. Graphic displays of the networks themselves and various graphic and tabular displays of the results are possible, including those of pressure distribution, various contours, storage flows, time variations of water level, and operating costs. (See also W89-11033) (Friedmann-PTT)
W89-11034

FUZZY PROGRAMMING APPLICATIONS IN WATER DISTRIBUTION NETWORK DESIGN,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-11036

SOME RECENT EXPLICIT FRICTION FACTOR RELATIONSHIPS FOR THE ANALYSIS OF MULTIPLE RESERVOIR PIPELINE SYSTEMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering and Building Technology.
For primary bibliographic entry see Field 8B.
W89-11037

SYSTEM ANALYSIS OF AN IRRIGATION MAIN CANAL,
Utah State Univ., Logan. Dept. of Chemistry.
For primary bibliographic entry see Field 3F.
W89-11038

DEVELOPMENT OF A LOW COST COMPUTER PROGRAM TO CALCULATE PRESSURE DROPS FOR INCOMPRESSIBLE AND COMPRESSIBLE FLOW IN PIPING SYSTEMS,
Teesside Polytechnic, Middlesbrough (England). School of Information Engineering.
For primary bibliographic entry see Field 8A.
W89-11039

MOST ECONOMICAL PIPE TYPE OF A SPRINKLER SYSTEM,
Technical Inst. of Agriculture, Mussaib-Babylon. (Iraq). Dept. of Water Projects.
For primary bibliographic entry see Field 3F.
W89-11041

MINICOMPUTER DESIGN AND MANAGEMENT OF WATER SUPPLY SYSTEMS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-11042

FLUID TRANSIENTS IN PIPELINES AND NETWORKS-USE OF MICROCOMPUTERS FOR DESIGN AND ANALYSIS IN DEVELOPING COUNTRIES,
City Univ., London (England). Thermo-Fluids Engineering Research Center.
For primary bibliographic entry see Field 8A.
W89-11043

STEADY, OSCILLATORY AND TRANSIENT STATE SIMULATION AND HYDRAULIC NETWORKS CONTROL,
Sao Paulo Univ. (Brazil). Escola Politecnica.
For primary bibliographic entry see Field 8B.
W89-11044

PRESSURE TRANSIENTS IN WATER SUPPLY AND SEWAGE CONDUITS-MEASUREMENTS AND POSSIBILITIES OF MAKING COMPUTATIONS,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 8B.
W89-11045

PRESSURE TRANSIENTS IN PIPE NETWORKS,
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-11047

DEVELOPMENT OF A COMPUTER PROGRAM FOR THE CALCULUS OF WATER HAMMER PROTECTION DEVICES BY SENSITIVITY ANALYSIS,
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
For primary bibliographic entry see Field 8B.
W89-11048

EFFECT OF DATA ERRORS IN THE OPTIMIZATION OF THE SAINT-VENANT FLOOD ROUTING EQUATIONS,
Queen Mary Coll., London (England).
For primary bibliographic entry see Field 2E.
W89-11049

DEVELOPING AN INTERACTIVE HYDRAULIC SIMULATION AND OPERATION MODEL FOR BRANCHING CANAL NETWORKS,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 3F.
W89-11050

SIMULATION OF COUPLED AND UNCOUPLED PHENOMENA IN FLOATING BREAKWATER MODELS,
Pavia Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 8B.
W89-11051

FLOODS IN THE BRAHMANI DELTA IN ORISSA, INDIA,
Hydraulic Study Dept., Calcutta Port Trust, Calcutta, India.
For primary bibliographic entry see Field 2E.
W89-11052

IMPLICIT STRAIGHT CHARACTERISTIC METHOD TO SOLVE DIRECT AND INVERSE FLOOD ROUTING PROBLEMS,
Hydraulic Dept., Civil Engineering School Jordi Girona Salgado, 31-08034, Barcelona, Spain.

For primary bibliographic entry see Field 2E.
W89-11053

APPLICATION OF A NUMERICAL IMPLICIT MODEL TO AN IRRIGATION CANAL,
Technical Univ. of Lisbon (Portugal). Dept. de Engenhaira Rural.
For primary bibliographic entry see Field 3F.
W89-11054

STUDIES ON ROUTING OF FLOODS IN EPHEMERAL CHANNELS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-11055

FINITE ELEMENT TWO-DIMENSIONAL MODEL FOR FREE SURFACE FLOWS: VERIFICATION AGAINST EXPERIMENTAL DATA FOR THE PROBLEM OF THE EMPTYING OF A RESERVOIR DUE TO DAM-BREAKING,
Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica.
For primary bibliographic entry see Field 2E.
W89-11056

NUMERICAL MODELING OF DAM-BREAK FLOOD FORECASTING WAVE,
Institute of Technology, Baghdad (Iraq). Dept. of Irrigation.
For primary bibliographic entry see Field 2E.
W89-11057

SPECTRAL ANALYSES OF STATIONARY AND NON-STATIONARY WAVE FIELDS (ANALYSES SPECTRALES DE CHAMPS DE VAGUES STATIONNAIRES ET INSTATIONNAIRES),
Centre Univ. de Luminy, Marseille (France). Inst. de Mecanique Statistique de la Turbulence.
For primary bibliographic entry see Field 8B.
W89-11059

COMPUTER SIMULATION OF SUSPENDED SOLID DISPERSION IN GRAVITY CURRENT,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-11061

2D MODEL FOR STEADY AND UNSTEADY FLOWS,
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-11063

DRY BEDS AND SMALL DEPTHS IN 2-D CODES FOR COASTAL AND RIVER ENGINEERING,
Grenoble-1 Univ. (France). Centre de Recherche et d'Essais de Machines Hydrauliques.
For primary bibliographic entry see Field 2L.
W89-11064

DYNAMICS OF THE HUGLI ESTUARY IN INDIA--NUMERICAL INVESTIGATION,
Hydraulic Study Department, Calcutta Port Trust, Calcutta, India.
For primary bibliographic entry see Field 2L.
W89-11065

NUMERICAL PREDICTION OF THE EFFECT OF WATER ABSTRACTION UPON TIDAL CHARACTERISTICS OF THE MEGHNA DELTA,
Institute of Flood Control and Drainage Research, Dacca (Bangladesh).
For primary bibliographic entry see Field 2L.
W89-11066

8. ENGINEERING WORKS

8A. Structures

OPEN CHANNEL FLOW THROUGH TRANSVERSE FLOOR OUTLETS,
Concordia Univ., Loyola Campus, Montreal (Quebec). Dept. of Civil Engineering.
A. S. Ramamurthy, D. M. Tran, and L. B. Carballada.
Journal of Irrigation and Drainage Engineering JIDEDH, Vol. 115, No. 2, p 248-254, April 1989. 3 fig, 2 tab, 7 ref, 2 append.

Descriptors: *Trash racks, *Storm drains, *Flow characteristics, *Diversion structures, *Model studies, *Open-channel flow, Outlet channels, Mathematical models, Floor outlets, Hydraulic engineering, Hydroelectric plants.

To solve the general problem of flow through floor outlets, downstream conditions were incorporated in a model while deriving an expression for the outflow. The study of subcritical flow through floor outlets or bottom racks in rectangular open channels has direct applications in horizontal trash-racks of hydro power plants, in curb outlets of streets and in general to divert flow from one stream to another. An understanding of the flow behavior over bottom racks or floor outlets is very important for the proper design of such flow diversion works. In earlier studies, an expression for the discharge through a single transverse floor outlet located in an open channel has been studied under free flow conditions. Here, the dependence of the diverted discharge on the downstream conditions is investigated. Specifically, the outflow is expressed as a function of flow characteristics in the channel upstream and downstream of the floor outlet. A simple design chart is developed to aid hydraulic engineers to divert the required flow through bottom outlets of open channels. Experimental data are presented to verify the model. (Author's abstract)
W89-10561

NONLINEAR SEISMIC ANALYSIS OF ARCH DAMS,
Impell Corp., Walnut Creek, CA.
M. J. Dowling, and J. F. Hall.
Journal of Engineering Mechanics JENMDT, Vol. 115, No. 4, p 768-789, April 1989. 13 fig, 1 tab, 42 ref. NSF Grants CEE-8317257 and CES-8619908.

Descriptors: *Seismic properties, *Arch dams, *Dam stability, *Construction joints, *Earthquakes, *Mathematical models, Cracking, Earthquake engineering, Dams, Reservoirs, Tensile stress, California, Finite element method.

Examination is made of the effect of the opening of vertical contraction joints and predetermined cracking planes on the earthquake response of arch dams. A nonlinear finite element procedure for arch dams is described in which the gradual opening and closing of vertical contraction joints and predetermined horizontal cracking planes are considered. A special joint element approximately represents the deformations due to plane sections not remaining plane at each open joint and allows a single shell element discretization in the thickness direction to be used for the dam. Compressive and sliding nonlinearities are not included. Finite element treatments are also used for the water, assumed incompressible, and for the foundation rock, assumed massless, with all degrees of freedom (dof) off the dam condensed out. For efficiency in the computations, the condensed water and foundation matrices are localized in a way which maintains good accuracy. The response of Pacoima Dam to the 1971 San Fernando ground motion, recorded on a ridge over one abutment and scaled by two-thirds, is computed first for water at the intermediate level that existed during the 1971 earthquake and then for a full reservoir. In the first analysis, the dam exhibits pronounced opening and separation of the contraction joints, allowing violation of the no-slip assumption. The presence of a full reservoir greatly increases the dam response, enough to bring some of the other assumptions of the analysis into question. Reducing the ground motion scale to 0.44 with a full reservoir drops the response back to a reasonable level, but the contraction joint separations remain. (Author's abstract)
W89-10573

FLUSH-JOINT THREADS FIND A HOME,
For primary bibliographic entry see Field 8G.
W89-10675

DESIGN CRITERIA FOR FLOOD DISCHARGE AT CHINA'S HYDRO SCHEMES,
Ministry of Energy, Beijing (China).
C. Xuemin.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 14-17, April 1989. 2 fig, 12 tab.

Descriptors: *Flood discharge, *Hydroelectric plants, *Dam design, *Spillways, *China, Design criteria, Streamflow forecasting, Project planning.

Large floods occur regularly on China's major rivers; flood prediction and the design of appropriate flood discharge structures are therefore important considerations in China's hydropower development. Design criteria have been formulated to specify different flood discharge requirements for projects of different sizes and importance. These are discussed, as well as types of spillway used in China. Two examples of unusual arrangements for dam and powerhouse layout in a narrow valley are described: one where the spillway is located over the roof of the powerhouse, and the other where the powerhouse is inside an overflow dam. (Author's abstract)
W89-10686

AUTOMATED DATA MANAGEMENT FOR DAM SAFETY EVALUATIONS,
Corps of Engineers, Washington, DC.
For primary bibliographic entry see Field 7C.
W89-10688

ENHANCING THE SAFETY OF STRATHCONA DAM,
British Columbia Hydro and Power Authority, Vancouver.
N. M. Nielsen.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 26-30, April 1989. 4 fig, 3 ref.

Descriptors: *Dam stability, *British Columbia, *Earth dams, *Dam design, *Safety, *Earthquake engineering, *Flow shutoff system, Turbines, Inlet valves, Strathcona Dam, Canada.

In the event of a moderate or greater earthquake, the power intake tower at Strathcona Dam, British Clumbia, Canada, would be likely to fail. If flow in the power conduit were not shut off, failure of the earthfill dam could occur. To prevent this, it was decided to provide an automatic flow shutoff system at the downstream end of the conduit. An earthquake will be detected by the seismic triggers, which will initiate closure of turbine wicket gates and turbine inlet valves. In addition, strengthening of the intake tower against earthquakes is being considered to improve electric system reliability. (Author's abstract)
W89-10689

STATISTICS OF DAM FAILURES: A PRELIMINARY REPORT,
Coimbra Univ. (Portugal). Seccao Autonoma de Engenharia Civil.
J. L. Serafim, and J. M. Coutinho-Rodrigues.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 30-34, April 1989. 3 tab.

Descriptors: *Dams, *Dam failure, Statistics, Surveys, Dam foundations, History.

Preliminary results are presented of research which is continuing by the ICOLD Ad Hoc Committee on Statistical Interpretation of Dam Failures. Data from 24 countries on events spanning three centuries are included. A total of 142 dam failures are listed, with the types of dams and their foundations classified according to the codes used in the ICOLD publication Deterioration of Dams and Reservoirs. A questionnaire is included, and readers are urged to send the committee data to complete the survey. (Sand-PTT)
W89-10690

INFLUENCE OF POSSIBLE FAULT OFFSETS ON DAM DESIGN,
T. M. Leps.
International Water Power & Dam Construction IWPCDM, Vol. 41, No. 4, p 36-43, April 1989. 10 fig, 17 ref.

Descriptors: *Engineering geology, *Dam design, *Dam failure, *Geologic fractures, Arch dams, Gravity dams, Concrete dams, Earth dams, Rockfill dams, Dam foundations, Geologic joints, Construction joints, Drains, Case studies.

Dam designers have begun to realize that not only should dams be evaluated for resistance to seismic shaking, but their capability to survive potential fault displacements in their foundations should also be assessed. Safety reviews of existing dams suggest that the original geological-seismic evaluations of some dam sites had failed to recognize the existence of possibly active faults through a lack of modern fault evaluation techniques. Nine examples are described of dams built on possibly active faults in California, in which the designers consciously considered fault activity and incorporated defensive detailing against breaching. As a result of the historic trend towards thin, multi-curved highly stressed arch dams, with the resulting need for nearly perfect, homogeneous foundations, there may not be an acceptable defensive design measure against potential fault offsets for thin arch dams. For new, concrete gravity dams, a defensive design measure to be considered would be based on a design which utilizes a special joint constructed within one block of the dam to accommodate strike-slip displacement along the fault. Another design for new concrete gravity dams could be the provision of a zoned, self-healing berm of embankment materials at the heel of the dam. This measure would provide the adjustability to any mode of foundation rupture; the thickness of the zones would be modified to suit the estimate of maximum credible offset. For new embankment dams, the most adaptable type to significant fault displacements is the rockfill type, either with earth cores or with central or upstream slope impervious membranes. For new earthfill dams, a design featuring internal drains backed up by a non-destructible collector and outfall drain system, would seem to be practical and effective. For existing dams of all types, if modifications against serious faulting is concluded to be essential, possibly the most practical and reliable defensive measure would be the provision of a buttressing berm of free draining granular fill against the downstream face. (Sand-PTT)
W89-10691

COQUITLAM LAKE WATER TUNNEL UPGRADING--DESIGN AND CONSTRUCTION, A CASE HISTORY,
Stewart-EBA Consulting Ltd., Vancouver (British Columbia).
F. Huber.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 90-102, February 1989. 13 fig, 1 tab, 8 ref.

Descriptors: *British Columbia, *Hydraulic engineering, *Tunnel construction, Reservoirs, Rehabilitation, Construction methods, Coquitlam Lake, Vancouver, Water supply, Tunnels, Concretes.

Geotechnical and construction aspects are described of a water supply tunnel upgrading project in the Coquitlam River valley, northeast of Vancouver, British Columbia. The tunnel conveys potable water from Coquitlam Lake, a major source of water for the Vancouver area, to below Coquitlam dam, into large-diameter supply mains. This project involved the enlargement of the existing tunnel in rock, and sand and gravel, and the construction of a new tunnel through a wide variety of ground conditions, including stiff silt and clay, sand and gravel with up to 12 m of groundwater head in the tunnel horizon, and granodiorite rock. Numerous costly excavation methods were evaluated. The entire project was on a very tight construction schedule because Coquitlam Lake is an essential source of water during the warm summer months. To facilitate timely completion of the project, a decline was driven to intersect the existing tunnel about halfway between the intake and south portal outlet, providing the contractor with two additional faces to work from. Numerous types of ground were used, including rock bolts, steel sets, and fiber-reinforced shotcrete. Construction was started in July 1986 and completed in May 1987. A total of 786 m of tunnel or decline was driven. (Author's abstract)
W89-10750

BUILDING IN RESERVOIRS,
Metcalf and Eddy of New York, NY.
J. Anderson, W. B. Sinnott, and E. C. Scheader.
Civil Engineering CEWRA9, Vol. 59, No. 1, p 50-53, January 1989. 1 fig.

Descriptors: *Construction, *Reservoirs, *Gates, *Rehabilitation, *Cofferdams, Water conveyance, Croton Supply System, New York, Dams, Aqueducts, Water supply, Civil engineering, Hydraulic structures.

The Croton Supply System, one of three water management systems serving New York City, is being overhauled, with the rehabilitation of existing structures and the construction of new facilities. In an innovative use of space, some of this construction is taking place inside the two main reservoirs, Croton Lake and Jerome Park Reservoir. A New Gate House had to be sited to tie into two other gate houses submerged in the New Croton Lake Reservoir. With the water supply rerouted to avoid the construction area, the contractor built one of the largest cofferdams in the Northeast, formed by nine individual cells connected in an arch between an existing masonry retaining wall and the existing gate house. Construction of the substructure of the New Gate House is currently underway. Meanwhile, the Jerome Park Reservoir must soon accommodate a new treatment plant. Because of high land costs, the reservoir itself was selected as the optimum site. A dividing wall separating the reservoir into two sections will enable it not only to hold raw incoming water, but also to store treated water from the new plant. When completed in 1990, the dividing wall will contain nearly 38,000 cu yd of reinforced concrete. The foundation mat is now under construction with single pours exceeding 2,500 cu yd. (Doria-PTT)
W89-10814

WATER JETS FIGHT SILT,
Armwavers Ltd., South Bend, WA.
R. A. Heinz, J. A. Bailard, and S. A. Jenkins.
Civil Engineering CEWRA9, Vol. 59, No. 1, p 54-57, January 1989.

Descriptors: *Dredging, *Desilting, *Jets, *Silting, *Harbors, Port facilities, Grays Harbor, Washington, Sediments, Dams, Navigation, Water currents, Scour, Cost analysis, Dredging, Civil engineering.

The nation's largest and most powerful array of hydraulic scouring jets is in place at the Port of Grays Harbor in Washington. This antisiltation system has been successfully maintaining a predredged depth at a cargo ship berth since May 1987. It has proven its economic worth and is now being doubled in length to clean sediments from the adjacent berth. The jet array system resuspends newly deposited sediments so they can be transported by the ambient current, a concept with applications at other waterfront facilities, navigation structures, irrigation canal headworks, and dams. The technique will work where there are adequate currents, from river flow, tide circulation, or artificial flows such as sluicing systems. Consolidation of newly deposited fluid mud is directly related to the time it remains immobile. The jet array system disrupts the process by a high velocity jet discharging horizontally through the floc layer. Surveys indicate that the vast majority of the sediments was carried down the harbor. The jets create a false bottom for the river and sweep it twice each day, giving the sweepings back to the river. (Author's abstract)
W89-10815

BUILDING A BETTER LANDFILL LINER,
McClelland Engineers, Inc., Houston, TX.
For primary bibliographic entry see Field 5G.
W89-10819

MICHIGAN WATER WELL GROUTING MANUAL: A GUIDE FOR THE CONTRACTOR,
Michigan Dept. of Public Health, Lansing. Div. of Water Supply.
M. S. Gaber, and B. O. Fisher.
Report No. GW-3-302, January 1988. 83p, 26 fig, 10 tab, 37 ref, 4 append.

Descriptors: *Well casings, *Grouting, *Water pollution prevention, *Manuals, *Handbooks, *Michigan, Materials engineering, Concrete, Bentonite, Administrative agencies, Regulations, Pumps.

The sealing of annular spaces around a well casing created during the drilling procedure has long been recognized as an important practice in protecting groundwater supplies. Field activities by the Michigan Department of Public Health, Ground Water Quality Control Section and local health departments have shown well grouting to be an area of significant noncompliance. This is largely a result of lack of enforcement resulting from inadequate staffing levels within regulatory agencies and lack of industry training regarding well grouting practices. This manual explains the importance of well grounting and describes ineffective grouting practices, such as using drilling mud and cuttings or depending on borehole collapse for casing sealing or pouring slurries down the well annulus from the surface, and contains technical information relating to the grouting materials cement and bentonite clay. Mixing procedures, grout pumps, placement methods, and grouting regulations are also discussed. The manual is specific to Michigan, but also contains information which has general application for the water well industry. (Lantz-PTT)
W89-10989

COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.
For primary bibliographic entry see Field 7C.
W89-11033

OPTIMAL DESIGN OF PIPE NETWORKS: A REVIEW,
Exeter Univ. (England). Dept. of Engineering Science.
For primary bibliographic entry see Field 5F.
W89-11035

SOME RECENT EXPLICIT FRICTION FACTOR RELATIONSHIPS FOR THE ANALYSIS OF MULTIPLE RESERVOIR PIPELINE SYSTEMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering and Building Technology.
For primary bibliographic entry see Field 8B.
W89-11037

DEVELOPMENT OF A LOW COST COMPUTER PROGRAM TO CALCULATE PRESSURE DROPS FOR INCOMPRESSIBLE AND COMPRESSIBLE FLOW IN PIPING SYSTEMS,
Teesside Polytechnic, Middlesbrough (England). School of Information Engineering.

For primary bibliographic entry see Field 8A.
W89-11039

DEVELOPMENT OF A LOW COST COMPUTER PROGRAM TO CALCULATE PRESSURE DROPS FOR INCOMPRESSIBLE AND COMPRESSIBLE FLOW IN PIPING SYSTEMS,
Teesside Polytechnic, Middlesbrough (England). School of Information Engineering.
H. C. Ward.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 65-78, 8 fig, 1 tab.

Descriptors: *Computer programs, *Pipelines, *Hydraulic structures, *Hydraulic properties, *Hydraulic systems, *Pipe flow, *Mathematical studies, *Conveyance structures, Water conveyance, Pressure head, Hydraulic properties.

A program was developed to fill the gap between small manual calculations and big network analysis that requires an elaborate commercial software package, for calculating pressure drops in incompressible and compressible flow in piping systems. The program was adapted for use with low cost desk-top personal computers. The program was designed such that it is not necessary for the user to understand the operation of the computer of the details or the program. Data entered by the user is a response to a prompt or menu. The user can choose between incompressible or compressible flow, referred to as the LIQUID and GAS subroutines, respectively. The subroutine LIQUID calculates both the head loss due to friction and the change in static head for incompressible flow in a piping system. The static head is calculated as the end elevation minus the start elevation. The subroutine GAS calculates the pressure drop due to friction for compressible flow in a piping system. This subroutine is based upon the conceptual problem of the user knowing the inlet pressure to the piping system, the desired flow rate, and the geometry of the piping system, the unknown being the outlet pressure at the discharge of the system. As with most engineering software, it is necessary for the user to prepare basic data on the piping system and the fluid in a format that is acceptable to the program. Once this list of properties has been prepared and a sketch of the piping system is completed, the operation of the program is simple. (See also W89-11033) (Friedmann-PTT)
W89-11039

MINICOMPUTER DESIGN AND MANAGEMENT OF WATER SUPPLY SYSTEMS,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-11042

FLUID TRANSIENTS IN PIPELINES AND NETWORKS-USE OF MICROCOMPUTERS FOR DESIGN AND ANALYSIS IN DEVELOPING COUNTRIES,
City Univ., London (England). Thermo-Fluids Engineering Research Center.
A. R. D. Thorley, and D. J. Wood.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 117-145, 11 fig, 5 tab, 17 ref.

Descriptors: *Pipelines, *Alteration of flow, *Hydraulic systems, *Computers, *Conveyance structures, *Pumps, *Risks, *Hydraulic structures, Water supply, Developing countries, Hydroelectric plants, Fluid flow, Fluid mechanics.

The analysis of fault conditions and fluid transients in pipelines tends to be surrounded by too much mystery, with this part of the design process often being left to 'the experts.' While it is still necessary to understand the basic concepts to appreciate the possible consequences of rapidly changing flow situations, much can be done by competent network designers to assess the nature and scale of the risks to which their system is exposed before calling in the specialist. Some types of system are at greater risk than others, especially the relatively simple pipelines. The most common hazard is the uncontrolled pump trip, possible due to a power failure. Associated with pump trips is the phenomenon of check valve slam. Systems most at risk are multi-pump systems when one or two or more running pumps is tripped. Also at risk are single pump systems where surge protection is an air vessel downstream of the pump. Some effective strategies for dealing with these problems include extending the effective operating time of a valve, and moderation of the speed with which changes to flow rates would otherwise occur. This can be attained with air vessels, surge tanks, feed tanks, relief valves, air inlet-outlet valves, etc. Examples of computer analyses, relevant to developing countries, that can be undertaken on microcomputers, are presented. These are applied to water supply pipelines, small hydro-electric schemes, and network analysis. (See also W89-11033) (Friedmann-PTT)
W89-11043

SIMULATION OF COUPLED AND UNCOUPLED PHENOMENA IN FLOATING BREAKWATER MODELS,
Pavia Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 8B.
W89-11051

RELIABILITY ANALYSIS OF RUBBLE-MOUND BREAKWATER,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
K. Mizumura, M. Yamamoto, and T. Endo.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 375-384, 6 fig, 6 ref.

Descriptors: *Rock fill, *Shore protection, *Breakwaters, *Hydraulic structures, *Wave action, *Sea walls, Mathematical equations, Mathematical studies, Monte Carlo method, Wave refraction, Hydraulic properties, Fluid mechanics, Wave runup, Friction.

When designing rubble-mound breakwaters, the weight of an armor unit for given design wave height, slope and water depth is computed by employing Hudson's formula. The reliability of the weight of an armor unit computed by Hudson's formula was investigated using the condition of three kinds of incipient motion of an armor unit under wave action. The reliability for the movement of armor units of the rubble-mound breakwater was calculated by the Monte Carlo method. The Hudson formula has an uncertainty value such as the effect of wave period, repose angle and friction coefficient of armor units, probabilistic property waves, etc. The failure probability of the rubble-mound breakwater based on the stability analysis of armor units is computed and the relative damage numerically obtained is compared with the observed one. The computed relative damage was in good agreement with that actually observed. Overall, large values of the significant wave height gave large values of the failure probability. Heavy weights of armor units take small values of the failure probability. (See also W89-11033) (Friedmann-PTT)
W89-11060

8B. Hydraulics

EQUATIONS DESCRIBING SPRINKLER DROPLET VELOCITY,
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W89-10553

ROUGHNESS VALUES FOR OVERLAND FLOW IN SUBCATCHMENTS,
National Univ. of Singapore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-10557

NEW DRAIN FLOW FORMULA,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 2F.
W89-10558

SLOPING CREST CRUMP WEIR,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-10559

CRITIQUE OF THE HVORSLEV METHOD FOR SLUG TEST ANALYSIS: THE FULLY PENETRATING WELL,
Chirlin and Associates, Inc., Rockville, MD.
For primary bibliographic entry see Field 2F.
W89-10684

APPLIED HYDROLOGY,
Illinois Univ. at Urbana-Champaign. Hydrosystems Lab.
For primary bibliographic entry see Field 2E.
W89-10963

COMPUTER METHODS AND WATER RESOURCES: FIRST INTERNATIONAL CONFERENCE, MOROCCO 1988.
For primary bibliographic entry see Field 7C.
W89-11033

SOME RECENT EXPLICIT FRICTION FACTOR RELATIONSHIPS FOR THE ANALYSIS OF MULTIPLE RESERVOIR PIPELINE SYSTEMS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering and Building Technology.
P. W. France.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 45-51, 1 fig, 2 tab, 8 ref.

Descriptors: *Flow friction, *Pipelines, *Computer programs, *Pipes, *Networks, *Conveyance structures, *Water conveyance, *Friction, *Hydraulic structures, Physical properties, Viscosity, Reservoirs, Mathematical studies, Multireservoir networks.

Several recently developed explicit formulas for the determination of the friction factor are shown to be usable with the quantity balance method to compute the flows in a system of pipes linking a number of reservoirs. Each formula was incorporated into an efficient but versatile computer program to solve a multiple junction reservoir problem and the results are compared with a direct Colebrook-White solution. With the exception of Chen's formula, excellent agreement was obtained with all explicit relationships. This approach can be used with any liquid provided that the kinematic viscosity is known. (See also W89-11033) (Author's abstract)
W89-11037

STEADY, OSCILLATORY AND TRANSIENT STATE SIMULATION AND HYDRAULIC NETWORKS CONTROL,
Sao Paulo Univ. (Brazil). Escola Politecnica.
E. Koelle, and C. R. Ribeiro.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 147-160, 8 fig, 6 ref.

Descriptors: *Simulation, *Hydraulic systems, *Hydraulic properties, *Networks, *Conveyance

structures, *Water distribution, Water supply, Water conveyance, Water management, Pipelines, Pipes, Computer programs.

The method of characteristics, using a staggered cross-grid, is used in a general way to calculate steady, oscillatory and transient flow in hydraulic networks. The use of a scheme of temporal evolution of the variables is suggested in order to define the simulator that will permit real time operational control of flow in water distribution networks designed to supply the probable demands, that vary in time, specified for the various consumers. An example of the application of MOC is presented for use in a network composed of twelve ENOS, seven pipes, one booster installation for raising the piezometric level of the network, and two secondary networks. The use of MOC is recommended, since it allows expeditious programming using a sole morphology and model in order to represent and calculate the state variables associated with the flow. (See also W89-11033) (Friedmann-PTT)
W89-11044

PRESSURE TRANSIENTS IN WATER SUPPLY AND SEWAGE CONDUITS-MEASUREMENTS AND POSSIBILITIES OF MAKING COMPUTATIONS,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
L. Jonsson.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 161-172, 7 fig, 3 ref.

Descriptors: *Water conveyance, *Sewer systems, *Pipes, *Pipelines, *Pressure head, *Hydraulic structures, Hydraulic engineering, Penstocks, Risks, Conveyance structures, Disasters, Hydroelectric plants.

Results are presented from a project on pressure transients in water supply and sewage conduits in Sweden. The main purpose of the project was to acquire field information on the transients for different conditions and to evaluate the possibilities of computing the transients with existing numerical models based on the ordinary 1-D pressure transient equations. Special emphasis is placed on cases where simple computations cannot reproduce measurements very well. Pressure transient cases presented include an example of detailed flow structure of transient flow, a very short conduit where inertia of check valve must be known, a case where agreement is good between measurement and computation, and a low pump sump level causing suction of air into the conduit. The best results were obtained when homogeneous water column and quasi-steady behavior of hydraulic components and friction can be assumed. Results showed, however, that discrepancies might occur if these assumptions cannot be made. Proper consideration of such cases requires additional data and/or more sophisticated models. (See also W89-11033) (Author's abstract)
W89-11045

PROFILE EFFECT ON PIPEBURST FLOW,
S. S. Vasudev.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 181-187, 4 fig, 6 ref.

Descriptors: *Rupturing, *Pipes, *Pipelines, *Pressure head, *Penstocks, *Hydraulic structures, Hydroelectric plants, Hydraulic engineering, Risks, Conveyance structures, Water conveyance, Disasters.

Pipeburst emergencies can prove catastrophic to the safety of a hydro plant. The transient velocities that are set up in a penstock in which a burst has occurred at its downstream end are of a very high order. Unless the air vents provided downstream of emergency valve are large enough, the resulting negative pressures could cause collapse of pipe. The profile of a penstock has an important bearing on the development of pipeburst velocities and the analytical computations presented predict severe consequences in a convex type profile. The inherent risks present in several prototypes in a pipeburst emergency bear a reassessment in the light of analytical predictions. (See also W89-11033) (Author's abstract)
W89-11046

PRESSURE TRANSIENTS IN PIPE NETWORKS,
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
A. Batamio de Almeida, and J. Pereira.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 189-201, 5 fig, 1 tab, 5 ref.

Descriptors: *Pipes, *Pipelines, *Networks, *Simulation, *Hydraulic systems, *Pressure head, Mathematical equations, Mathematical studies, Hydraulic properties, Economic aspects, Model studies, Computer models, Hydrodynamics, Water conveyance, Topology.

The numerical simulations of pressure transients in very large and complex pipe networks by the method of characteristics is presented. The small computers are now powerful enough to help the engineer to solve this problem. By accepting some simplifications and special modelling techniques, this kind of analysis can be done in an economical way: the water-hammer analysis or the operational dynamic response of a large network can be obtained by using the complete hydrodynamic equations of the method of characteristics. Some new topics are presented, including the non-reflective boundary condition, the parametric study of the influence of lateral pipes on the pressure variations, and the time step optimization for the simulation of the steady or quasi-steady flow regimes. A case study is presented, with the main water distribution system inside of Lisbon, Portugal, as an example of a near open-domain pipe network, where it was almost impossible to model all the pipes. The purpose of the study was to detect critical areas where there is the risk of subatmospheric pressures and/or excessive overpressures after total or partial pumps' trip-off. Additional devices for protection against the water-hammer effects (e.g. air vessels) were proposed as well as other equipment to avoid high pressures in any operational condition. Pressure envelopes along all the pipes and pressure and discharge time variations on pipe sections were plotted. The program used in this case can simulate any network topology. (See also W89-11033) (Friedmann-PTT)
W89-11047

DEVELOPMENT OF A COMPUTER PROGRAM FOR THE CALCULUS OF WATER HAMMER PROTECTION DEVICES BY SENSITIVITY ANALYSIS,
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
E. Cabrera, J. Garcia-Serra, F. Sanz, and F. Planells.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 203-215, 5 fig, 1 tab, 8 ref.

Descriptors: *Water hammer, *Computer programs, *Hydraulic structures, *Sensitivity analysis, Mathematical studies, Pumping plants, Hydraulic systems, Switching surges, Pipelines, Algorithms, Hydraulic design.

A computer program based on a general methodology to calculate the water hammer protection devices using sensitivity analysis, is presented. The case of a pumping station with a check valve at the beginning of the pipe and a reservoir at the end have been implemented. The program allows determination of the characteristic parameter of the protection element that adjusts the maximum upsurge and/or downsurge of the transient to the prefixed values, at whatever point is chosen in the pipe. An iterative algorithm has been developed and its convergence is reached in very few iterations. The method of calculation is thus quasi-direct. In all the processed cases, the first iteration gives the extreme pressures, with an error of less than 5% respect to the previously fixed values. The program also carries out an analysis with adimensional parameters, in order to determine the efficiency of a larger protection device, and represents a graph of maximum upsurge and minimum downsurge of the water hammer in the check valve, as a function of the protection device's parameter at each side of the start values. The traditional graph methods of Parmakian, Kinnow, Stephenson, etc., are tested for predesigning protective elements. (See also W89-11033) (Author's abstract)
W89-11048

SIMULATION OF COUPLED AND UNCOUPLED PHENOMENA IN FLOATING BREAKWATER MODELS,
Pavia Univ. (Italy). Inst. of Hydraulics.
M. Fugazza, and L. Natale.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 241-251, 6 fig, 9 ref.

Descriptors: *Floating structures, *Simulation, *Breakwaters, *Hydrodynamics, *Wave refraction, *Computer models, Flow around objects, Model studies, Wave action, Linear programming, Comparison studies, Numerical analysis.

Most proposed linear models for simulation of the hydrodynamic behavior of floating breakwaters follow the classical scheme of superposition of elementary solution: wave diffraction around fixed surface obstacle, motion of the moored body caused by the wave, change of the wave field due to waves generated by breakwater motion. It is shown that in the particular case of floating breakwater, the superposition neglects important effects of coupled phenomena and introduces an error into the simulation. Further, the results given by two different numerical methods using a coupled and an uncoupled model, are compared, and the experimental tests carried out in the laboratory tank are discussed. The results of the comparison show that the behavior of the floating breakwater is fully explained only by the coupled model. Experimental tests showed that the turbulence generated by the movement of the body does not considerably affect the hydrodynamic phenomenon in most practical cases. The coupled model is reliable, precise and easy to use, so that it can be advantageously implemented for numeraical solution in the study of floating breakwater. (See also W89-11033) (Friedmann-PTT)
W89-11051

SPECTRAL ANALYSES OF STATIONARY AND NON-STATIONARY WAVE FIELDS (ANALYSES SPECTRALES DE CHAMPS DE VAGUES STATIONNAIRES ET INSTATIONNAIRES),
Centre Univ. de Luminy, Marseille (France). Inst. de Mecanique Statistique de la Turbulence.
B. Chapron, and M. Bourguel.
IN: Computer Methods and Water Resources: First International Conference, Morocco, 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston, 1988. p 363-374, 5 fig, 13 ref. No English summary.

Descriptors: *Spectral analysis, *Wind waves, *Waves, *Hydraulic properties, Air-water interfaces, Oscillatory waves, Wave height, Wavelengths, Canals.

An attempt was made to test the validity of certain theoretical mehtods applied to wave fields. The experiments were conducted at Grande Souflerie, Luminy, France on air-water interactions. At different points along the length of the canal, surge-generators produced various, instantaneous levels of water in the presence or absence of wind. Each experiment measured the length, frequency and

amplitude of the oscillations. Wave propagation was shown to be unidirectional along the canal. (See also W89-11033) (Peters-PTT)
W89-11059

RELIABILITY ANALYSIS OF RUBBLE-MOUND BREAKWATER,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W89-11060

2D MODEL FOR STEADY AND UNSTEADY FLOWS,
Katholieke Univ. Leuven (Belgium). Dept. of Civil Engineering.
C. S. Yu, M. Fettweis, R. De Bruyn, and J. Berlamont.
IN: Computer Methods and Water Resources: First International Conference, Morocco 1988. Vol. 2, Computational Hydraulics. Computational Mechanics Publications, Boston. 1988. p 403-414, 7 fig, 8 ref.

Descriptors: *Model studies, *Steady flow, *Unsteady flow, *Flow characteristics, Flow pattern, Numerical analysis, Mathematical equations, Computer models, Model testing, Hydraulic models, Hydraulic properties.

A two-dimensional depth-averaged numerical model based upon an alternating direction implicit scheme has been developed. The equations are solved by using the split-operator approach with 'falsificaton' of the individual stages of the ADI scheme. A modification is proposed to get accurate results for both steady and unsteady problems. The model has been verified by comparing the results with those of other numerical schemes, with analytical solutions and with field data. The time-centered scheme is unconditionally stable and can be efficiently implemented on computer. Applications of both steady and unsteady flow cases gave good results. The possibility of using grid refinement increases the applicability of this model. (See also W89-11033) (Friedmann-PTT)
W89-11063

8C. Hydraulic Machinery

DESIGN CRITERIA FOR FLOOD DISCHARGE AT CHINA'S HYDRO SCHEMES,
Ministry of Energy, Beijing (China).
For primary bibliographic entry see Field 8A.
W89-10686

BUILDING IN RESERVOIRS,
Metcalf and Eddy of New York, NY.
For primary bibliographic entry see Field 8A.
W89-10814

NEW TECHNIQUES IN WINDMILL PUMPS(TECHNIQUES NOUVELLES POUR LE POMPAGE EOLIEN),
Paris-6 Univ. (France). Lab. de Mecanique Experimentale des Fluides.
For primary bibliographic entry see Field 5F.
W89-11040

DEVELOPMENT OF A COMPUTER PROGRAM FOR THE CALCULUS OF WATER HAMMER PROTECTION DEVICES BY SENSITIVITY ANALYSIS,
Universidad Politecnica de Valencia (Spain). Dept. of Hydraulic and Environmental Engineering.
For primary bibliographic entry see Field 8B.
W89-11048

8D. Soil Mechanics

GEOTECHNICAL INVESTIGATIONS OF DREDGED OVERBURDEN AT THE SYNCRUDE OIL SAND MINE IN NORTHERN ALBERTA, CANADA,
Syncrude Canada Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 5E.
W89-10751

8E. Rock Mechanics and Geology

NONLINEAR SEISMIC ANALYSIS OF ARCH DAMS,
Impell Corp., Walnut Creek, CA.
For primary bibliographic entry see Field 8A.
W89-10573

INFLUENCE OF POSSIBLE FAULT OFFSETS ON DAM DESIGN,
For primary bibliographic entry see Field 8A.
W89-10691

SETBACKS FROM THE CRESTS OF SLOPES ALONG THE NORTH SASKATCHEWAN RIVER, ALBERTA,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
D. M. Cruden, K. H. Tedder, and S. Thomson.
Canadian Geotechnical Journal CGJOAH, Vol. 26, No. 1, p 64-70, February 1989. 9 fig, 2 tab, 22 ref.

Descriptors: *Slope stability, *Alberta, *Geohydrology, *Civil engineering, *Geomorphology, Groundwater, Slope degradation, Slopes, Urbanization, Management planning, North Saskatchewan River, Prediction, Infinite slope analysis, Setbacks, Land use.

In developing urban areas that include river valleys, setbacks from the valley crests need to be established to avoid development encroaching on slopes experiencing movements now or in the future. Setbacks from the crests of slopes along the North Saskatchewan River between Edmonton and Fort Saskatchewan can be estimated from the ultimate angle of the slope and the rate of lateral river erosion. The ultimate slope angle depends on the slope stratigraphy and the position of the water table in the slope. Three slopes, in overburden, with a bedrock base, and dominantly in bedrock, typically having groundwater tables at, respectively, the toe of the slope, halfway up the slope, and at the low quarter of the slope height, were studied. Theoretical estimates of the ultimate slope angle in each type, from infinite slope analysis and from charts, agree with observations of the inclinations of abandoned slopes along the river valley. The procedure recommended represents a rational estimation of setback distances without extensive site investigations. (Author's abstract)
W89-10747

8F. Concrete

COMPRESSIVE STRENGTH OF CEMENT CONTAINING ASH FROM MUNICIPAL REFUSE OR SEWAGE SLUDGE INCINERATORS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Toxic Chemicals Lab.
For primary bibliographic entry see Field 5E.
W89-10734

8G. Materials

DIFFUSIVE CONTAMINANT TRANSPORT IN NATURAL CLAY: A FIELD EXAMPLE AND IMPLICATIONS FOR CLAY-LINED WASTE DISPOSAL SITES,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5B.
W89-10657

FLUSH-JOINT THREADS FIND A HOME,
S. Foster.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 55-58, Spring 1989. 1 fig.

Descriptors: *Well casings, *Well screens, *Pipes, *Plastics, Physical properties, Strength, Hydrostatic pressure, Flush-joint threads.

With the rapid growth of PVC in the well casing and screen market, many different applications and methods of use have surfaced. One major method of fastening or joining thermoplastic well casings is the flush-joint thread. Widespread use of flush-joint threads on Schedule 40 and Schedule 80 pipe has caused concern about the physical strength and hydrostatic integrity of these threads. These concerns are magnified when one discovers the multitude of different manufacturers, each with his own thread design. Committee F17 of ASTM has passed a change in the Standard F480, which is now: ASTM F480-88A Standard Specification for Thermoplastic Well Casing and Couplings Made In Standard Dimension Ratios, Schedule 40 and Schedule 80. This change partially consists of incorporating specifications for flush-joint threads in Schedule 40 and Schedule 80 casing, in sizes 1/2 inch to 16 inch in Schedule 80 and 2 inch to 16 inch in Schedule 40. This standard now ensures field thread compatibility with all pipe specified with this standard. It also requires manufacturers to cut a functional and reliable thread. Extensive testing has been done to determine the physical properties of the specified thread. The three tests that help the purchaser determine the working parameters of this flush-thread include: tensile test of threaded joint, internal hydrostatic pressure test, and external pressure test. Using ASTM guidelines methods were developed for testing this thread. Results show that the new thread specification in F480 is a valid and functional design. (Author's abstract)
W89-10675

SHOULD WE USE A WELL FOOT (SEDIMENT TRAP) IN MONITORING WELLS,
J. K. Yu.
Ground Water Monitoring Review GWMRDU, Vol. 9, No. 2, p 59-61, Spring 1989. 7 ref.

Descriptors: *Observation wells, *Monitoring wells, *Groundwater quality, *Wells, *Sumps, *Monitoring, Well screens, Costs, Water sampling, Standards, Aquifers.

It is common practice in the water well industry to install a well foot below the screen in a production well. Some practicing engineers and hydrologists also insist that the well foot should be installed on monitoring wells. The RCRA Ground Water Technical Enforcement Guidance Document advocates that 'the installation of a sump at the bottom of a monitoring well will prolong the operating life of the screen and also capture intermittent dense-phase contaminants for analysis.' It is the opinion of the author that a well foot is not necessary for monitoring wells. Its elimination reduces the cost of the monitoring well and it will not extend the well life nor improve the representativeness of the water sample obtained from the aquifer. (Sand-PTT)
W89-10676

ORGANIZATION AND OPERATION OF THE SAVANNAH RIVER PLANT'S GROUNDWATER MONITORING PROGRAM,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 7A.
W89-10678

TRACER TEST FOR DETECTING CROSS CONTAMINATION ALONG A MONITORING WELL COLUMN,
EBASCO Services, Inc., Chicago, IL.
For primary bibliographic entry see Field 5A.
W89-10679

EQUIPMENT DECONTAMINATION PROCEDURES FOR GROUND WATER AND VADOSE ZONE MONITORING PROGRAMS: STATUS AND PROSPECTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.

For primary bibliographic entry see Field 5A.
W89-10682

FLEX: AN EXPERT SYSTEM TO ASSESS FLEXIBLE MEMBRANE LINER MATERIALS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5E.
W89-11004

LOCATING AND REPAIRING LEAKS IN LANDFILL/IMPOUNDMENT FLEXIBLE MEMBRANE LINERS,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5G.
W89-11005

8I. Fisheries Engineering

UNDERWATER DAM AND EMBAYMENT AERATION FOR STRIPED BASS REFUGE,
Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of Environmental Engineering JOEDDU, Vol. 115, No. 2, p 428-446, April 1989. 11 fig, 4 tab, 8 ref, append.

Descriptors: *Aeration, *Barriers, *Environmental control, *Hypolimnion, *Bass, *Fish management, *Reservoir fisheries, Fish barriers, Bays, Temperature control, Water temperature, Aerated lagoons, Dissolved oxygen, Reservoir operation, Tennessee, Anadromous fish, Dams.

A submerged fabric dam was constructed underwater across the mouth of a small cove in a large reservoir, Cherokee Reservoir in northeastern Tennessee. The dam as constructed was 315 ft long, 70 ft wide in the middle where the embayment was deepest, and approximately 40 ft wide along the tapered ends. The dam trapped cool hypolimnetic water in the spring and prevented it from being withdrawn for hydropower releases throughout the summer. A liquid oxygen aeration system aerated the water trapped behind the dam. The purpose of the dam and aeration system was to provide an artificial refuge for striped bass. The bass have historically suffered in summer months from unsuitable dissolved oxygen (DO) and temperature conditions in the reservoir. The dam has promise for providing different aquatic conditions in portions of a large reservoir compared to those of the main reservoir body. Such dams, therefore might be used to provide optimal conditions for both warmwater and coldwater species in the same reservoir. They could also provide an inexpensive alternative to aeration of an entire reservoir or changes in reservoir operation to furnish the desired aquatic conditions. Such dams, on a scale larger than described here, might also be used to allow hydropower projects to release cooler water later in the summer. Cooling the release from a reservoir in warm months could help maintain a coldwater fishery in the tailwater and reduce stress on migrating fish such as salmon. (Author's abstract)
W89-10582

ISOLATION OF THREE WATER MOLDS FROM TWO FRESHWATER FISHES AND INSECT EXUVIAE,
Scientific Research Council, Baghdad (Iraq).
For primary bibliographic entry see Field 2H.
W89-10587

FISH FAUNA OF CURUA-UNA RESERVOIR, SANTAREM, PARA: II. FOOD AND FEEDING HABITS OF THE MAIN SPECIES (A ICTIOFAUNA DA REPRESA HIDRELETRICA DE CURUA-UNA, SANTAREM, PARA.: II. ALIMENTACAO E HABITOS ALIMENTARES DAS PRINCIPAIS ESPECIES),
For primary bibliographic entry see Field 2H.
W89-10592

STUDIES ON TWO MIGRATORY FISH FROM LOWER TOCANTINS RIVER BEFORE CLOSURE OF TUCURUI DAM (ESTUDOS SOBRE DOIX PEIXES MIGRATORIOS DO BAIXO TOCANTINS ANTES DO FECHAMENTO DA BARRAGEM DE TUCURUI),
Instituto Nacional de Pesquisas da Amazonia, Manaus (Brazil).
J. L. De Carvalho, and B. De Merona.
Amazoniana, Vol. 9, No. 4, p 595-607, June 1986. 8 fig, 5 tab, 18 ref. English summary.

Descriptors: *Dam effects, *Fish migration, *Fisheries, *Dams, Tocantins River, Brazil, Tropical regions, Spawning.

Migratory fish species are generally the most important species for the fishing industry as well as for artesanal fishing. In the lower Tocantins, Brazil, two species of migratory fish dominate the captures: the mapara (Hypophthalmus marginatus) and the curimata (Prochilodus nigricans). These species were studied before the damming of this river by the Tucurui hydroelectric dam as part of a larger study of commercial fisheries encompassing the Tocantins basin from the mouth to Maraba (Para). Based principally on landing records, this study describes the migration cycles of the two species. A classical and simple pattern of migration can be recognized: an upstream movement of immature forms and adults in the upper part of the distribution area, and the reverse or downstream movement of larvae and adults in a dispersion phase. The main difference between these two species lies in the size of the distribution area. The mapara is limited to part of the river downstream from the dam, and so would not be affected by its presence. The curimata has a much larger geographic range in the Tocantins basin. The part of the population living downstream will probably be profoundly perturbed by the dam due to the blockage of its migratory route. (Author's abstract)
W89-10600

STUDIES IN THE FISHWAY MODELS,
Oulu Univ. (Finland). Lab. for Hydraulic and Water Resources Engineering.
J. Hooli.
Aqua Fennica AQFEDI, Vol. 18, No. 2, p 171-178, 1988. 8 fig, 9 ref.

Descriptors: *Fish management, *Fish barriers, *Fish ladders, *Hydraulic engineering, Fish behavior, Salmon, Trout, Whitefish, Structural models, Fish passages.

In order to conduct field experiments of fishways, scale models were constructed in Keminmaa and at the Kirakkakongas hydropower plant. The models were made for a fishway with vertical slots. The Kirakkakongas model was 30 m long with a vertical ascent of 2 m. The Keminmaa model was made on a scale of 1:4. The ascent behavior of fish was studied at discharges of 30-100 L/s. The depth of the basins was 30-60 m. The Keminmaa model allowed evaluation of different experimental designs, measuring equipment, and the methodology of fish behavior experiments. The Kirakkakongas model made it possible to carry out parallel and more detailed experiments. At Karakkakongas most fish swam up to the lower basin from the entrance downstream, in which the flow was strengthened by the flow from the lower channel. The flow velocity was 0.3-1.5 m/s, depending on the magnitude of the discharge used in the mouth of the fishway. In the Kirakkakongas fishway, fish swimming behavior was significantly affected by the temperature of the water and the flows in the basins and openings. At the lowest discharge (33 l/s), most fish swam up and at the highest (100 L/s) only a few swam up. At the lowest discharge it was possible to obtain flow conditions in the model in which whitefish of different sizes were able to swim without difficulty. The suitable flow rate greatly depends on the species for which the fishway has been designed. For trout and salmon the flow can be very strong but whitefish require a calmer flow. In the Keminmaa models the greatest proportion of the fish swam up the fishway when the water temperature was 16-19 C. The origin of the fish did not affect their rising activity. The best discharge for whitefish in this fishway model was 25-35 L/s. At lower discharges the whitefish also rose well. At discharges over 35 L/s, the swimming was uncontrolled and only a few whitefish were able to swim up. The rising activity of whitefish increased towards autumn, although the water was still warm. Fish swam up most actively in the morning. (Author's abstract)
W89-10612

HIGH CALCIUM CONCENTRATION IN WATER INCREASES MORTALITY OF SALMON AND TROUT EGGS,
Fish and Wildlife Service, Cortland, NY.
H. G. Ketola, D. Longacre, A. Greulich, L. Phetterplace, and R. Lashomb.
Progressive Fish Culturist PFCUAY, Vol. 50, No. 3, p 129-135, July 1988. 6 tab, 7 ref.

Descriptors: *Water chemistry, *Water quality, *Fish eggs, *Salmon, *Trout, *Fish farming, *Calcium, *Hardness, Gypsum, Mortality, Salmon, Salvelinus.

Several experiments were conducted to investigate the effect of water chemistry during water hardening on survival of eggs of Atlantic salmon (Salmo salar), rainbow trout (S. gairdneri), and brook trout (Salvelinus fontinalis). Survival was very low when eggs were exposed to very hard water containing high concentrations of Ca (520 mg/L or greater) during the first few hours of water hardening. Such high concentrations of Ca were associated with gypsum (calcium sulfate) in the water supply. In contrast, survival of eggs significantly increased when they were initially water-hardened (1-3 h) in softer water (34-64 mg/L Ca). Incubation of eggs in high-Ca water after the initial water-hardening period did not significantly effect survival. Results of an experiment on water hardening of rainbow trout eggs showed a significant increase in survival when eggs were initially water-hardened in either low-gypsum water or in high-gypsum water softened by ion exchange to markedly reduce the Ca, but not the sulfate, content. (Author's abstract)
W89-10625

USE OF OZONE AND FLUIDIZED-BED BIOFILTERS FOR INCREASED AMMONIA REMOVAL AND FISH LOADING RATES,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
M. H. Paller, and W. M. Lewis.
Progressive Fish Culturist PFCUAY, Vol. 50, No. 3, p 141-147, July 1988. 3 fig, 3 tab, 11 ref.

Descriptors: *Wastewater treatment, *Fish farming, *Water treatment, *Water reuse, *Biological treatment, *Biofilters, *Ozonation, *Ammonia, Nitrites, Nitrogen fixing bacteria, Fluidized bed process, Fixed bed reactor, Activated carbon.

A water reuse system incorporating ozonation and a fluidized-bed, granular carbon biofilter supported approximately six times more fish than a conventional system of identical size and flow rate that incorporated oxygenation and a fixed-bed gravel biofilter. Increasing the hydraulic loading rate to 44 mL/sq cm/s in an upflow granular activated carbon biofilter caused the carbon particles to become suspended in upflow currents (fluidized) and tripled ammonia removal. Ozonating the water prior to sedimentation, physical filtration, and biofiltration also increased ammonia removal by reducing organic matter concentrations and favoring the growth of nitrifying bacteria over heterotrophic bacteria in the biofilter. Ozonation directly reduced nitrite concentrations by oxidation, and it reduced turbidity. Ammonia removal per unit volume was a more useful criterion for evaluating fluidized-bed biofilters than ammonia revoval per unit of substrate surface area. (Author's abstract)
W89-10626

ECOLOGICAL PLANNING: A POSSIBLE METHOD FOR THE CHOICE OF AQUACULTURAL SITES,
Montpellier-2 Univ. (France). Lab. d'Hydrobiologie Marine.

For primary bibliographic entry see Field 6A.
W89-10664

BIOMANIPULATION IV: DENSITY AND FEEDING ACTIVITY OF PLANKTIVOROUS FISH (BIOMANIPULACJA. IV: ZAGESZCZENIE I AKTYWNOSC POKARMOIVA RYB PLANKTONOZERAYCH),
Warsaw Univ. (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5G.
W89-10805

MOVEMENT AND SPAWNING OF SEVERAL FRESHWATER FISHES IN TEMPORARY WATERS AROUND PADDY FIELDS (IN JAPANESE),
Kyoto Univ. (Japan). Dept. of Fisheries.
K. Saitoh, O. Katano, and A. Kotzumi.
Japanese Journal of Ecology JJECDN, Vol. 38, No. 1, p 35-47, April 1988. 7 fig, 5 tab, 7 ref. English summary.

Descriptors: *Irrigation ditches, *Spawning, *Rice, *Flood irrigation, Fish behavior, Fish migration, Productivity.

Paddy fields and ditches around irrigation creeks constitute temporary waters flooded only in summer. In order to consider the significance of such temporary waters for fish, the movement and behavior of fish in temporary waters and a permanently filled creek were investigated near the town of Yagi, Kyoto Prefecture. Among 23 species identified in the study area, seven species were seldom found in the temporary waters, in spite of their abundance in the permanent creek. The remaining fourteen identified species were rare in the study area. Fish which frequently utilized the temporary waters for spawning had a similar reproductive habit, i.e. they scattered many eggs widely and showed no parental care. Many fish, including juveniles, forage on the plankton which become abundant in the temporary water after irrigation. It is surmised that newly emerged habitats of temporary waters with high productivity serve for the maintenance of a rich fish fauna in irrigation creeks. (Author's abstract)
W89-10854

AMMONIA REMOVAL ALLOWS EFFLUENT REUSE AT FISH HATCHERY USING FLUIDIZED BED REACTORS,
Dworshak National Fish Hatchery, Ahsahka, ID.
For primary bibliographic entry see Field 5D.
W89-10908

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